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ABSTRACT

The Mathematics Inquiry in the Conrad Area (MICA) Project had as its general focus the installation of a variety of teaching approaches, with emphases on open-ended units. The purpose was to give teachers exposure to the diversity of possible approaches, to use and test the effectiveness of the methods, and to familiarize other teachers with the methods and results. Success of the project was based on student achievement and attitude changes toward mathematics. Evaluation procedures and instruments are included along with statistical data and results. (JP)

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CONRAD AREA SCHOOL DISTRICT

MICA
1972-73
Outcome Evaluation Report

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Conrad Area School District

MICA

1972-73

Outcome Evaluation Report

July, 1973

Dr. Richard Koch
Project Director

Leon Elder
Superintendent

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I. Identifying Information (Cover of Report)

A. Project Title

MICA (Mathematics Inquiry in the Conrad Area)

B. Period of evaluation

July 1, 1972 - June 30, 1973

C. Name and address of agency

Conrad Area School District
99 Middleboro Road
Wilmington, Delaware 19804

D. Project number

ESEA III 72-35
ESEA III 73-16
ESEA III 72-5 (carryover)

E. Project Director

Dr. Richard R. Koch

F. District Superintendent

Leon B. Elder

G. Funding agency

Elementary and Secondary Education Act of 1965, Title III, P.L. 89-10, as amended

H. Date report submitted

July, 1973

I. Brief History and General Goal(s) of the Project

A. Who was involved in writing the proposal and/or getting the project underway

The primary responsibility for writing and implementation was the district supervisor of matnematics, Dr. Richard Koch. Input was received from participating teachers, aides, assistant director, principals, and the Delaware Department of Public Instruction.

B. Why the project was initiated

1. The related local educational need(s)

The educational need for the project was the development of model teaching techniques in mathematics instruction and the dissemination of such techniques.

The critical educational needs to which the project is addressed are priorities 2, 3, 4, and 6 in the Educational Needs For Delaware approved by the State Board of Education on October 21, 1971:

2. To foster the pupil's self-concept and motivation to learn so that he may develop respect for knowledge as well as respect for himself and others.

3. To construct, expand, or improve basic curriculum programs (Mathematics, Reading, etc.) in order to meet the student's interests and abilities.

4. To develop programs emphasizing individualized instruction to meet the goals and objectives of the students.

6. To provide experiences and exercises so that all students may improve their skills in problem-solving and decision-making.

2. The general focus of the project and its major purpose(s)

The general focus was the installation of a variety of teaching approaches in the area of mathematics, with emphases on open-ended units; manipulative materials; estimation; measurement; data collection and display; utilization of small group instruction; games for drill and reinforcement; and diagnostic tests.

The purpose was to give teachers exposure to the variety of possible approaches, to use and test the effectiveness of the methods, and to familiarize other teachers with the methods and results.

II. Specific Purposes of the Project (FY'73)

A. Clear statement of objectives

The performance objectives (in terms of students) for the project are:

(1) Students, grades K-8, will demonstrate more favorable attitudes toward mathematics after using teaching techniques promoted by MICA as measured by SMSG attitude measures or semantic-differentials.

(2) Students, grades K-8, will demonstrate improved understanding of mathematics concepts and improved computational skill as measured by the California Test of Basic Skills and/or criterion referenced measures listed in behavioral objectives.

(3) Students, grades K-6, will perceive patterns more often and will indicate the correct selection to complete or continue the given pattern or sequence as measured by the Houghton Mifflin Academic Abilities Test.

The first objective deals with student preference for mathematics and mathematics-related activities as compared to choices in non-mathematics activities such as reading. It also measures student choice between preference and aversion for mathematics and mathematics-related activities.

Objective (2) refers to student understanding of place value, computational algorithms, the nature of the various types of numbers, geometric figures, etc., as listed in Chapter VI of MICA Summer Workshop Report[1] or in the refined list of behavioral objectives developed in the 1971 summer workshop.

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[1]Koch, Richard R., MICA Summer Workshop Report - Wilmington, Delaware: Conrad Area School District, 1970).

[2]Koch, Richard R., Behavioral Objectives Constructed by MICA Teachers in 1972 Workshop for Criterion - Referenced Evaluation Measures - Wilmington, Delaware: Conrad Area School District, May, 1973

The third objective includes recognition of: (1) identical figures in the same orientation or in different orientations (such as turned); (2) a figure in a complex figure with distracting lines or segments; (3) a figure when only part is visibly demonstrated; (4) the parts of a figure when the figure is divided into portions and the portions are separated; (5) a sequence of figures or numbers with a common pattern.

B. Statement of special areas investigated during FY'73

Special areas investigated follow the objectives including attitudes toward mathematics, mastery of mathematics concepts and computational skills.

A special consideration was the study of the effect of the workshop on the teachers. This effect was analyzed in detail in the publication entitled MICA, 1971 Summer Workshop Report, published in December, 1971 by the Conrad Area School District.

IV. Description of the Project (FY'73)

A. Major parts of the project and their functions

The major aspects of the project included:

(1) an inservice summer workshop for teachers to prepare teachers for the project

(2) an operational phase which included:

(a) instructional aides and assistant director to assist teachers

(b) materials, supplies and equipment needed for instruction

(3) follow up inservice sessions for participating teachers

(4) an evaluation phase

(5) an administrative phase, involving a secretary for typing and record keeping

(6) a dissemination phase

B. Essential nature of the project's operation during FY'73 including:

1. Instructional sequence

Where appropriate, diagnostic tests were administered. Instructional methods and materials were then utilized to meet particular needs, including developmental, remedial, reinforcement, and enrichment.

2. Time devoted to each part of the project

The workshop required 4 weeks, four hours per day. The operational phase required one hour per school day for each teacher at the elementary level, not including preparation time. The junior high teachers required at least two hours per day for intensive work with students utilizing the ideas of the project and the remainder of the school day on less intensive use with other students; not including preparation time. Follow-up sessions required one evening session. Evaluation entailed about two months of the assistant director's time. Dissemination required one or two days each month of the director's time and the time of the assistant director. Between one hundred and two hundred hours of the various teachers were utilized in demonstrations to other teachers within the district and outside the district.

3. Materials used

Typical of the instructional materials used were listening stations, cassette players or recorders, and cassettes; audio-visual equipment such as laminating press, overhead projectors or filmstrips viewers; instructional materials such as abaci, geoboards, Cuisenaire rods, Stern materials, tools for measuring, mathematics games, activity cards, drill and practice kits and graph paper. Typical materials for administrative use included folders, binders, stationery, and labels. Equipment purchased for administrative use primarily included storage cabinets.

4. Types of instruction offered

Instruction was in the area of mathematics and included the following methodology:

a. Grouping within the classroom

b. Use by the entire class or group of manipulative devices such as Cuisenaire rods or abaci

c. Independent student study using film-strips, printed materials, etc.

d. Discussion groups (led by teacher or students) which emphasize interaction

e. Small groups presented lessons through listening stations where several students hear through earphones a common lesson recorded on a tape recorder

f. Open-ended units where student responses will differ

g. Non-routine drill or reinforcement through games such as BINGO built on addition facts

h. Imaginative story telling built on mathematical sentences

i. Units on analysis of data built upon data gathered from experiments

j. Diagnosing and remediation of individual weaknesses

k. Independent study through simple oral and written instruction with respect to handling of concrete objects to build mathematical concepts

l. Use of the overhead projector for demonstrations

m. Laboratory type activities such as measuring, summarizing data, and graphing

5. Facilities

Facilities used were regular self-contained classrooms in buildings built between 5 and 50 years ago.

6. Special problems encountered and how they were handled

One special problem was the lack of students in the district who were not contaminated in some way by the influence of the project. Identification of appropriate control classes was impossible. Instead, simple pre-post comparisons were made with some comparison to comparable periods in previous years for control classes. Criterion-referenced objectives and measures were also used as a substitute evaluative measure as opposed to experimental-control classes.

The lack of district audio-visual and public relations specialists hindered dissemination efforts. The lack of time and expertise by the project director in these areas severely limited formal dissemination through media and printed brochures. Informal dissemination occurred by teacher influence on peers, through district inservice programs, and through a presentation at the regional convention in Philadelphia of the National Council of Teachers of Mathematics. Media such as the International Clearinghouse on Science and Mathematics Curricular Development and state publications were used.

C. Personnel involved (FY'73)

1. Teachers

Thirty-one teachers who had been trained in MICA workshops utilized materials and methods and served as models for other teachers. Names of these teachers and grade levels (kindergarten through senior high) are listed in Table 6. Four were teachers in two participating parochial schools. Several were teachers of special education. All five of the district elementary schools, two of the three junior high schools, the senior high school, and both parochial schools in the district were represented by these teachers who formed the core of the instructional staff for school year 1971-72.

Table 1 shows a roster of the 24 teachers and aides who participated in the 1972 workshop. In addition, five other teachers who previously attended workshops participated on a part-time basis to assist in instructing and sharing ideas. Characteristics of participants in summer workshops (age, experience, certification, and educational level) are summarized in Tables 2 and 3.

Table 1. MICA Workshop Roster, 1973

Name	School	Grade Level
Miss Marianne Bors	Corpus Christi	3
Miss Theresa Branson	St. Matthew's	7
Mrs. Theresa Celano	Spruce Avenue	5
Mrs. Janet Chalfant	St. Matthew's	Aide
Mrs. Jeanne Ciecko	Krebs Elementary	Special Ed.
Mrs. Linda Davis	Spruce Avenue	5
Mrs. Carroll Deese	Richey	Special Ed.
Mrs. Wilhelmina Doll	Krebs Elementary	4
Mr. Peter Ferrario	Richardson Park Jr. High	Junior High
Sr. Maurice Hartnett	St. Matthew's	6
Mrs. Marguerite Klepcyk	Richardson Park Elem.	Kindergarten
Mrs. Frances Leach	Krebs Jr. High	Junior High
Mrs. Ruth Locke	Richardson Park Elem.	Aide
Mrs. Betty Moran	Richey	2
Miss Mary Muraoka	Spruce Avenue	6
Mrs. Carol Paiper	St. Matthew's	Aide
Mrs. Elaine Quirico	Conrad High School	High School
Mrs. Correne Sauls	Richey	1
Mrs. Emily Seymour	Spruce Avenue	Aide
Mr. Larry Trone	Richardson Park Elem.	5,6
Miss Diane Vicorek	Krebs Elementary	Special Ed.
Mrs. Ellen Willard	Poplar Avenue	Kindergarten
Miss Therese Wright	Spruce Avenue	6
Mrs. Margaret Weldin	Spruce Avenue	5

Table 2. Frequency Distribution of Teachers Participating in MICA Workshops With Respect to Age, Years of Experience, Certification, and Education Level.

Characteristics	Number of Teachers and Aides				
	1970	1971		1972	
		Conrad Only	Total	Conrad Only	Total
AGE					
21-25	4	4	5	10	11
26-30	6	4	4	5	6
31-35	1	1	2	0	1
36-40	0	2	2	0	1
41-45	1	1	2	2	2
46-50	0	2	2	4	4
51-55	1	1	1	1	2
56-60		1	1	1	1
61-65		1	1	1	1
YEARS OF EXPERIENCE					
0-2	4	5	5	11	13
3-5	6	3	5	3	4
6-8	2	5	5	4	4
9-11	1	1	2	2	3
12-14		2	2	1	1
15-17		-	-	1	1
24-27		1	1	2	2
28-30		-	-	0	1
CERTIFICATION					
Professional	4	8	9	8	8
Standard	5	7	7	13	15
Limited Standard	2	1	2	1	1
Provisional	1	1	1	-	-
None	1	0	1	2	5
EDUCATIONAL LEVEL					
High School				1	3
Bachelor's	9	10	13	17	19
Bachelor's + 30	2	3	3	3	4
Master's	2	2	2	2	2
Master's + 30		1	1	1	1
Master's + 45		1	1	0	0

Table 3. Mean and Median Age and Years of Experience of New Participants in the MICA Workshops.

	1970	1971 Conrad	1971 All	1972 Conrad	1972 Total
Mean Age	30	37	36	34	35
Median Age	27	33	33	28	29
Mean Years of Experience	3.8	6.8	6.7	6.4	6.9
Median Years of Experience	3.0	6.0	5.0	3.0	3.0

MICA-trained teachers influenced other teachers who in turn practiced the techniques and influenced students. A partial list of these teachers, representing a secondary influence in 1972-73, is shown in Table 4. Five junior high and 40 public elementary teachers are included on the list. A comparable list of parochial teachers is not available.

The net effect on the teaching staff for 1972-73 is demonstrated in Table 5.

2. Students

The number of students directly affected by the Project for an extended period of time, by grade level and race is shown in Table 6. This includes only students taught by teachers trained in MICA workshops. Numbers are found to be over 1,200 in the public schools and an additional 300 students in non-public schools.

In addition, well over 1,000 elementary students in classes of teachers labeled as indirectly but significantly affected by Project MICA, and 800 junior high children in a similar category, benefited.

Altogether well over 3,000 students were influenced by Project MICA.

3. Administrative personnel

Administrative personnel consisted of:

(1) Dr. Richard P. Koch, Project Director and district Supervisor of Mathematics, former State Supervisor of Mathematics, who was employed by the project for two summer months to coordinate the summer workshop, write reports, and order materials. The director used most of his time during the year in coordinating the project, performing administrative detail, and conducting the workshop.

(2) The curriculum director and finance office personnel who supervised the program and processed financial records.

Table 4. Teachers Utilizing MICA Ideas in 1972-73 Who Have Not Formally Participated in Workshops.

School	Name of Teacher		
Richey	Cochran Gier	Paulsen Sharber	Stewart Strickland Vanicek
Poplar	Delaney Eckrich	Goverts Reddick	
Rich. Park Elem.	Faedtke Grodzicki	Ignatieff Poole	
Rich. Park Jr. High	Downey Myers		
Spruce Elementary	Anthony Boines Burdett Charlton DeLuca Dougherty	Dryden Dudley Gates Haslam Joswic Kroeber	Malone McLaughlin Sharpe Tosselli Ventresca Zimny
Oak Grove Jr. High	Moffitt Weiss		
Krebs Elementary	Carey Hughes	Hume Kelley	Peckham Rainey
Krebs Jr. High	Pauley		

Table 5. Number and Percentage of Conrad Area District Teachers Utilizing MICA, Directly or Indirectly, 1972-73.

School	No. of Teachers Affected by MICA	No. of Teachers in Staff Who Are Prospective Users	Percentage
Krebs Jr. High	2	3	67
Oak Grove Jr. High	2	5	40
Rich. Pk. Jr. High	3	3	100
Kreos Elem.	11	25	44
Spruce Elem.	27	32	84
Rich. Park Elem.	11	30	37
Richey	11	15	73
Poplar	6	17	35
Total Elem.	66	119	55
Total Jr. High	7	11	64
Total	73	130	56

Table 6. Students Served by Project MICA, 1972-73, by Teachers Who Participated in Workshop

Teacher	Level	Caucasian	Negro	Spanish Surname	Oriental	Total
Elementary						
Angeli	3	24	1	1		26
Bailey	6	34	1			35
Brenner	K	50		1		51
Celano	5	31				31
Ciecko	LD	8				8
Conaway	3	25				25
Davis	6	29				29
Deese	EMR	11	3			14
Doll	4	24	2			26
Dougherty	3	27				27
Frick	5	24				24
Groff	2	27				27
Hoellen	4	31				31
Joseph	4	30				30
Klepcyk	K	54	2			56
Moran	2	22	5		1	28
Muraoka	6	30				30
Sauls	1,2	20	3			23
Szot	6	32	1			33
Titter	EMR	15				15
Trone	5	130	1		1	132
Vicorek	EMR	7	3	1		11
Weldin	5	27				27
Willard	K	50				50
Wright	6	29				29
Secondary						
Ferrario	7	132	2	2		134
Leach	8	154	8			162
Quirico	10-12	92	2			94
Total Public		1,169	34	5	2	1,210
Elementary						
Bors	3	36				36
Hartnett	6	145	2			147
Monaghan	3	80	3			83
Secondary						
Branson	7	34				34
Total Non-public		295	5	0	0	300
GRAND TOTAL		1,464	39	5	2	1,510

4. Special support personnel (e.g., instructional aides, community agencies)

Mrs. Joann Megginson, a highly competent aide who served as assistant director, worked with all teachers in the project in all six schools. Mrs. Megginson administered most pre- and post- tests, particularly of control classes, scored creativity tests, led small groups of children in instruction, provided individual remedial instruction, conducted workshops for teachers not in the project. Mrs. Megginson worked with teachers in each school in two-week blocks of time whereby MICA teachers in that school used her services each day for that block of time. She also assisted in organizing and conducting the summer workshop.

One full-time and one part-time aide also worked with MICA teachers in two week blocks - testing, assisting teachers, working directly with students.

Miss Cynthia Gerace, in July and August, and Mrs. Edith Brady, from September through June, performed the secretarial duties - typing and binding reports and instructional units, ordering materials, record keeping, and the myriad of other duties required for the administration of the project.

5. Special characteristics of personnel

Characteristics of participating teachers have been summarized in items 1-4. Other personnel such as aides and secretaries met the typical district requirements for similar positions.

6. Selection and assignment of personnel

Teachers were recommended for the summer workshop by principals and by the project director to the superintendent. The main criteria were availability for the workshop and a desire to use the ideas with students the following year.

The schedule for the aides and assistant director was set by the project director in cooperation with the building principals.

V. Evaluation Methodology

A. Personnel conducting the evaluation

1. Name and title of personnel

The Project Director assumed responsibility for conducting the evaluation. The project director was Dr. Richard R. Koch, Supervisor of Mathematics for the Conrad Area School District.

2. Background and qualifications of personnel

Dr. Koch is the district Supervisor of Mathematics. He has had experience as Delaware State Supervisor of Mathematics for 9 years, was chairman of the mathematics and science departments at Delaware City High School, and has taught on a part-time basis for the University of Delaware.

He has a B.S. in mathematics from Muhlenberg College, an M.Ed. in natural sciences from the University of Delaware, and an M.A. in mathematics and an Ed.D. in mathematics education from Rutgers University.

He has been active in many professional organizations of mathematics and science teachers (such as NCTM) and of administrators such as DASA and DASCD).

B. Statement of decision areas and questions (hypotheses) investigated

Hypotheses investigated included:

1. Student attitudes will improve during the year.
2. Cognitive abilities and student perception of patterns will show positive change.
3. Student achievement in computation and understanding of mathematics concepts will improve.
4. Growth in achievement of experimental students will equal or surpass average district growth.
5. Student creativity will improve.

Other areas of investigation included:

1. Frequency of use of materials and methods.
2. Initiative for independent study displayed by MICA students.

3. Frequency of small group or independent study in mathematics by MICA teachers.
4. Effect of the workshop on teachers (See separate report) (Koch, Richard R., MICA 1972 Summer Workshop Report. Wilmington, Delaware: Conrad Area School District, June, 1972.)
5. Records of number and percentages of students who could achieve behavioral objectives before instruction and after instruction. See Figure 1 for form used for kindergarten classes, and Figure 2 for forms used by other classes.

C. Information collection:

1. Why the data was collected in terms of decision areas and questions (hypotheses) being investigated.

   Data was selected and collected that could give a measure of the objectives.

   Frequency counts were kept as a measure of the intermediate teaching procedures that were expected in turn to yield student gains in achievement and attitude.

2. What data was collected.

   Data collected included:

   (1) Measures of mathematics achievement utilizing the California Test of Basic Skills.
   (2) Measures of mental ability utilizing Cognitive Abilities Test by Houghton Mifflin.
   (3) Measures of attitude (utilizing scales with some variations from the SMSG longitudinal study) Alpha coefficients and subscores are shown in Table 7.
   (4) Measures of cognitive abilities - selections from specially constructed tests developed by Educational Testing Services to measure the 24 components of Guilford's model of the intellect. Names of instruments and the ability measured are shown in Table 8. No norms, validities, or reliability data are available for these research measures.
   (5) Measures of creativity - portions of the Torrance Tests of Creativity.
   (6) Frequency counts of small group instruction, student initiated independent study, and use of selected instructional methods and materials.
   (7) Measures of achievement of behavioral objectives by checklist during teacher observations.

Figure 1. Sample of Behavioral Objective Checklist

Child's Name _____ UNIT IV
MEASUREMENT

	Pre-Test	Final Evaluation	Comments - how easy or how difficult activities were to accomplish, etc.
Objective 4.1			
Objective 4.2			
Objective 4.3			
Objective 4.4			
Objective 4.5			
Objective 4.6			
Objective 4.7			
Objective 4.8			

igure 2. Behavioral Objective Checklist

acher's Name _____ Date: _____

(Check one)

_____ Pretest
_____ End of Marking Period 1
_____ End of Marking Period 2
_____ End of Marking Period 3
_____ End of Marking Period 4

eck students attaining objectives
complete mastery is expected or
ate percentage if a standard is
t.

Name of Student	1	2	3	4	5	6	7	8	9	10

Table 7. Attitude Scales Used in MICA Studies and Related Alpha Coefficients as Reported by Wilson (1968).

Scale No.	Direction of Favorable Score	Scale Description	Alpha	Item Number 2*	Item Number B*
A	Low.	Arithmetic vs. Non-Aritmetic	.57	5-11	5-13
F	Low	Arithmetic Fun vs. Dull	.70	17-20	17-20
S	Low	Actual Arithmetic Self Concept	.69	23-30	25-32
I	High	Favor Independent Study	-	35-36	40-42

*Primary = 2
Intermediate = B

Table 8. Measure of Cognitive Abilities Used in Project MICA.

Code	Name of Measure	Cognitive Ability Measured	Type of Score
G	Gestalt Competion	Speed of Closure	Number Right
I	Identical Figures	Perceptual Speed	Number Right -1/4 Number Wron
H	Hidden Figures	Flexibility of Closure	Number Right -1/4 Number Wron
F	Form Board	Visualization	Number Right
R	Card Rotations	Spatial Orientation	Number Right -Number Wrong

Creativity Tests were subdivided into verbal and non-verbal forms. Each of these was subdivided into activities.

In Activity 1 in the Figural Battery, Picture Construction, the student was asked to utilize a given irregular closed shape around which he constructed a picture no one else will think of which would tell an interesting and exciting story, together with a clever title.

In Activity 2 in the Figural Battery, Picture Completion, the student was given a series of ten incomplete figures from which he was to sketch interesting objects or pictures that no one else will think of and which together with a title, would tell a complete interesting story.

In Activity 3 in the Figural Battery, the student was given a series of identical figures such as circles or parallel lines. The student was asked to complete pictures which utilized the given figure with instructions for direction similar to those in Activities 1 and 2.

In Activity 4 in the Verbal Battery, Product Improvement, the student was shown a stuffed animal and was asked to list the cleverest, most interesting and unusual way to change the animal so that children would have more fun playing with it.

In Activity 5 in the Verbal Battery, Unusual Uses. the student was asked to list interesting and unusual uses of a common article such as tin cans or cardboard boxes.

In Activity 6 in the Verbal Battery, Unusual Questions, the student was asked to write questions about the article in Activity 5 which would lead to a variety of different answers and which might arouse interest and curiosity.

Cognitive abilities and perception of patterns included several subtests.

In the pattern measure, the student studied the pattern in a sequence of pictures and selected the one from a successive set which would best continue the pattern.

In the numerical measure, numbers were substituted for the patterns in the previous measure.

In Gestalt completion, most of the lines in a drawing are erased. From the remaining figure, the student must identify the object represented.

In card rotations, students are shown a figure followed by a series of figures, some of which are the same as the original figure but rotated. The student must indicate which ones are the same but rotated

In Identical Pictures, a figure is followed by a series of figures, some of which are identical, and some of which have missing or extra parts. The student identifi the identical pictures.

In Hidden Pictures, a figure is followed by a series of more complex pictures, one of which includes the original figure in the same orientation. The student must identify the correct one.

In Form Board, a figure is followed by a series of figures. The student must identify which ones can be assembled as a puzzle to form the original.

3. How the data was collected.

Most data collected were in the form of student tests and semantic differential measures of attitude. When students were poor readers, instructions and test questions were read orally to students.

4. When the data was collected.

Pretests were administered in September and October except for the California Tests of Basic Skills for which May, 1972 results were utilized. Posttests were administered in May. Frequency counts and checklists were taken each month throughout the year and forwarded to the project director's office.

5. Who collected the data.

Observations of students and administration of tests was performed by classroom teachers, project aides, and the assistant director, and secretary collect and assembled the data.

D. Data analysis procedures

1. Sampling unit used

The sampling unit consisted of half-a-class. Students in a class were randomly assigned, using tables of random numbers, to two subgroups. Each subgroup was administered a portion of the tests as a pretest and the same or different form of the same test as a posttest. Whole classes were used for achievement measures using the California Test of Basic Skills.

2. Special scoring procedures used

Scoring was done by hand by the aides, secretary, and assistant director except for the California Test of Basic Skills and Non-verbal Creativity Tests which were commercially scored.

Where appropriate, correction factors were used utilizing the formula:

Score = number right - number wrong x 1/(no. of choices-1)

Actual formulas used are shown in Table 7.

For the attitude measures, each possible response was given a numerical value and the values of the responses selected were added. Filler questions not dealing with mathematics were ignored in scoring. Such questions were added to the SMSG measures to make the mathematics directions measured less noticeable. Since low numbers were favorably disposed on some subtests and unfavorably disposed on others, the direction, alpha coefficients and actual questions for each subtest are shown in Table 6.

Four basic scoring measures were used in scoring creativity tests.

Fluency was a simple count of the number of relevant responses.

Flexibility was a count of the categories used by students in his responses and was a measure of student ability to change his thinking to new areas. Based on scoring experience, anticipated responses were classified into a number of categories. Examples are 1. Clothing, 2. Emotions, 3. Ethnic Matters, 4. Occupation, 5. Physical Action.

Originality was a measure of the rarity of the student response. Past student responses have been categorized. If a response frequently occurs, it was given a low numerical rating, 0. If a response rarely occurs, it was given a high rating of 4. These values were summed for the originality score.

Elaboration, used only in non-verbal tests was a numerical value assigned on the basis of the detail the student incorporated in drawings he was asked to make, displaying imagination and exposition of detail.

3. Treatment of missing or questionable data.

In cases for which pre- and posttest scores were not available for the same student, for the same measure, the student was excluded as a member of the group for that measure.

If information for a teacher with respect to frequency counts was missing for some months, all data for that teacher was dropped from the table of frequency counts.

4. Statistical procedures used.

For measures of growth from pre- to posttest, t-tests were used.

For other data, tables of frequency counts were completed and/or means computed.

The design for t-tests was Design 2 (The One-Group Pretest - Posttest Design) from Campbell and Stanley's section, Chapter 5, in Gage's Handbook of Research on Teaching:

$$O_1 - O_2$$

5. Significance level used.

Five percent levels of significance (on a one-tailed test) were used. Where significance was noted, higher levels of significance (1%, for example) were investigated and noted if found significant.

VI. RESULTS

A. Tables and figures including:

1. Appropriate labeling to let reader know exactly what data is being presented.

2. The number of cases or groups used for each analysis.

3. Data displayed in terms of decision areas and questions (Hypotheses) being investigated.

4. The identification of significant findings from "trends".

Teachers in the project were asked to keep frequency counts of (1) the number of days of small group or independent study in mathematics, (2) frequency of student requests for student-initiated independent study in mathematics, (3) frequency of use of selected

Table 9. Mean Number of Days of Small Group or Independent Study in Mathematics Classes of MICA Teachers.

Week Number	Mean Number of Days Used Per Week Per Teacher 1970-71 n=7	1971-72 n=20 (16 for weeks 32-37)	1972-73 n=31
1	.3	2.1	3.0
2	1.6	4.9	3.1
3	3.0	3.9	3.4
4	3.3	5.8	3.4
5	1.9	2.7	3.3
6	3.3	2.9	2.6
7	3.4	2.3	3.1
8	3.0	3.3	3.2
9	2.9	3.1	3.1
10	3.9	2.8	3.0
11	3.3	5.1	2.3
12	3.0	2.5	2.7
13	3.9	3.7	3.5
14	4.1	3.6	3.7
15	4.1	1.4	3.0
16	2.0	3.5	2.2
17	3.3	4.1	3.6
18	3.3	4.1	3.4
19	4.1	3.8	3.1
20	4.4	4.1	2.7
21	4.3	4.2	4.1
22	4.1	4.4	4.3
23	5.1	3.8	3.9
24	4.6	4.3	4.1
25	5.3	3.1	3.0
26	4.9	3.3	3.5
27	4.6	3.8	3.4
28	4.6	2.7	2.9
29	4.7	4.2	3.2
30	4.1	3.6	3.2
31	4.0	4.3	2.6
32	5.0	3.8	3.4
33	4.1	2.9	3.1
34	4.7	2.6	3.3
35	5.1	2.5	3.0
36	4.9	2.6	2.8
37	4.6	3.6	
38	4.7		
Total	3.8	3.4	3.2

Table 10. Frequency of Student Requests for Student-Initiated Independent Study in Mathematics in Classes of MICA Teachers.

Month	Mean Number of Student Requests Per Teacher 1970-71 n=6	1971-72 n=20 (16 for May, June)	1972-73 n=31
September	.8	12.4	4.2
October	3.5	12.0	7.8
November	5.8	12.2	6.4
December	7.0	10.0	6.3
January	8.7	18.0	6.6
February	6.0	11.8	5.8
March	7.7	14.6	7.2
April	7.0	15.9	8.2
May	10.3	8.8	13.0
June	5.3	4.8	2.6
Total	6.2	12.1	6.8

Table 11. Frequency of Use of Selected Teaching Methods or Devices by MICA Teachers.

Method or Device	Mean Frequency of Use Per Teacher Per Month 1970-71 n=5	1971-72 n=18	1972-73 n=31
Abaci	2.7	1.7	2.4
Activity Cards	3.2	2.2	2.3
Attribute Games	7.0	1.8	1.5
Count-a-Ladder	1.6	2.1	.9
Count-a-Line	.3	.6	.5
Cuisenaire Rods	3.5	1.5	1.7
Diagnostic Tests	.5	.4	.3
Drill & Practice Kits	2.2	4.7	4.7
Geoboards	3.0	2.5	2.8
Geometric Models	no tally	.2	1.0
Graphs	no tally	1.3	2.4
Listening Station	3.0	3.2	3.8
Math Games	4.0	7.4	6.7
Measures:			
Area	no tally	.7	.7
Length	no tally	1.3	1.0
Metric	no tally	.6	.6
Time	no tally	1.0	.9
Volume	no tally	.2	.3
Weight	no tally	.4	.4
Multi-Base Blocks	2.4	1.0	.7
Overhead Projector	2.4	2.8	4.8
Popsicle Sticks	2.8	1.8	1.0
Primary Rulers	1.4	1.4	1.2
REC Kit	2.2	.0	1.1
Stern Materials	1.4	1.4	1.4
Trundle Wheel	.0	.3	.2

methods or devices. Summaries are given in Tables 9 to 11.

For all 3 years, teachers averaged 3.5 out of 5 days per week in use of small group and independent study techniques for mathematics instruction.

The frequency of student requests for student-initiated independent study in mathematics can be seen to grow from the consummation of the project throughout the first year, leveling out at the beginning of the second year at twelve such requests per month. The second year results were heavily influenced by high responses from a kindergarten teacher, a first grade learning disabilities teacher, and a third grade teacher. Third year results averaged down to those of the first year - about twelve times per month.

The frequency of use of selected teaching methods and devices was once to twice each month per teacher, reflecting the variety of methods and materials used.

Data on the effect of the 1972 workshop on teachers is included in a separate report. See MICA 1972 Summer Workshop Report by Richard R. Koch as available from the Conrad Area School District.

Hypothesis 1 - Affective Domain

MICA students were predicted to improve attitudes as a result of the project. Using means shown in Table 12, those groups showing growth were determined and are listed in Table 12.

Analysis of t-tests for attitude measures showed, for the first measure, six categories changing favorably, one significant at the 5% level; nine changing unfavorably, two significantly. Changes in total means were unfavorable and would be significant on a two-tailed test.

In the second measure, ten categories changed favorably, two significant at the 5% level; six changed unfavorably, three significantly. Total means changed unfavorably (by a mere .1), which is not significant.

In the third measure, eight categories changed favorably, one of which was significant at the 1% level; eight categories changed unfavorably, two significantly. The total means changed unfavorably, significant at the 5% level on a one-tailed test.

Table 12 - Change in Mean from Pre to Posttest on Affective Measures of Experimental Students, 1971-72

Class Grade	Type	A N	Arith vs Non Arith.	Arith Fun VS Dull	Actual Arith Self-Concept	Favor Independent Study
8	Low	16	2.2	1.7	1.9	1.2
7	Average	22	4.7	3.0	4.7	-.1
6	Low	27	1.7	1.6	.7	.0
6	Average	39	.0	-.2	2.7	-.6
6	High	28	1.5	-.8	-.4	-.1
5	Low	10	1.5	.4	3.3	-.7
5	High	15	-1.0	-1.8	-.3	-.6
4	Low	8	-2.1	-.3	-1.7	1.1 *
4	Average	26	-.9	-.4	.7	.1
3	Low	8	1.8	1.8	1.6	3.0
3	Average	38	.5	-.1	-.3	-.5
2	Low	16	-1.1	-1.3	1.3	-.5
2	Average	12	2.0	.8	-.7	.0
Int EMR		10	-1.4	-1.7 *	-1.3	-.5
Int EMR		12	-1.6 *	-1.1 *	-4.1 **	.4
Int LD		5	-2.8	-1.4	-2.8	.2
TOTAL		293	.6	.1	.7	-.1

* Significant at 5% on a one-tailed test

** Significant at 1% on a one-tailed test

*** Significant at .1% on a one-tailed test

In the fourth measure, six categories changed favorably, eight changed unfavorably. One category showed a change which was statistically significant at the 5% level - favorably. Review of total mean showed a slight decline which was not significant.

Hypothesis 1 was not substantiated.

Design and analysis assume results would not normally change during this time span. This may or may not be a valid assumption. Attitudes may well retrogress normally with time. Results of previous administrations to control classes are shown in Table 13.

Table 13. Changes in Attitude Measures in Control Classes, 1970-71 1971-72

Subtest	Direction of Favorable Change	Change from Pre-Test to Post-T 1971-72 Primary	Intermediate	1970-7
Arithmetic vs Non-Arithmetic	Negative	1.3	-.2	-2.4
Arithmetic Fun vs. Dull	Negative	.4	.0	-1.2
Actual Arithmetic Self Concept	Negative	.8	.8	-2.1
Favor Independent Study	Positive	-.2	-.3	-1.6

Table 13 indicates inconsistencies in change. In 1971-72, the indications were that students' attitudes do retrogress. Thus while t-tests do not show significant increases, there may be evidence typical negative factors have been slowed.

Certainly no strong statement of improvements in attitude was substantiated

Hypothesis 2 - Cognitive Domain-Perception of Patterns

Experimental students were predicted to show growth. Changes in mean growth of the number of right responses and in accuracy are shown in Table 14. Accuracy and speed are combined in the one score which incorporates the correction factor for wrong answers.

Table 14. Change in Mean From Pre to Posttests in Cognitive Abilities Measures of Experimental Students, 1972-73

Class Grade	Type	N	Change in Mean in Respective Measure: Pattern	Numerical	N	Gestalt Completion	Identrial Figures	Hidden Figures	N	Form Board	Card Rotations
8	Low				14	1.2 **	2.9 *	-2.3	15	3.9	.7
7	Average	24	1.9*	1.2*	26	1.3 **	4.9 ***	.2	22	27.1 ***	-.4
6	Low	27	3.3**	2.6**	26	-.1	8.1**	1.1	27	35.3 ***	1.0
6	Average	42	2.6***	2.2***	42	-.1	.9	2.1**	41	20.4 ***	1.3*
6	High	38	2.9***	2.1***	34	.5	.0	2.3**	31	11.3 ***	1.3*
5	Low	20	3.2*	5.2***	21	-.3	2.5*	1.3	21	16.9 ***	1.4**
5	High	14	3.0*	1.4**	15	.8	-2.8*	2.5*	15	29.0 **	2.9**
4	Low	12	2.8*	8.2**	10	-.8	3.5*	-.1	8	9.0	-1.6
4	Average	24	3.2**	4.0**	23	-.1	1.6	1.0	26	21.8 ***	.4
3	Low	11	3.9*	4.2*	11	-.3	-10.0	-1.7	8	10.8 *	.3
3	Average	21	2.4**	5.1***	38	-.1	4.1*	1.2*	38	19.5 ***	.1
2	Average				23	-.0	9.0***	.2	27	6.7 ***	.5
Int.	EMR	7	.0	2.1	10	-.3	5.0	5.3***	9	11.1 **	-1.8
Int.	EMR	14	-2.1*	3.3**	15	.7	4.3**	-.1	14	-1.7	.3
Int.	LD	5	4.8*	5.8*	5	2.0	.3	1.4	6	- .7	2.3*
TOTAL		254	2.5***	3.2***	312	.2*	2.8***	1.1***	308	17.2***	.7***

* Significant at 5% on a one-tailed test

** Significant at 1% on a one-tailed test

*** Significant at .1% on a one-tailed test

Table 14 shows the results of the t-tests. The directions of change for various subtests and categories of students are mixed. Many classes showed growth that was statistical significant. Tests on the totals for each measure showed growth, significant at the .1% levels, except Gestalt completion which was significant at the 5% level. The most consistent favorable change is found in the Form Board instrument.

Hypothesis 3 was definitely supported by the statistical evidence.

Typical change in a non-experimental situation may again be useful to notice whether the amount or direction of chan normally occurs. Table 15 makes such comparison.

Table 15. Comparison of Changes from Pre to Post in Cognitive Measures for 1972-73 Experimental Students and Previous Control

Measure	Change from Pre to Post		
	1972-73 Experimental	1971-72 Control	1970-71 Control
Pattern	2.5		1.6
Numerical	3.2		.1
Gestalt Completion	.2	2.6	-1.1
Identical Figures	2.8	5.6	-7.8
Hidden Figures	1.1	1.2	1.0
Form Board	17.2	.9	-.5
Card Rotation	.7	13.2	10.0

Table 15 shows considerable variance in changes for control students in previous years. Casual review would indicate that, comparatively speaking, 1972-73 experimental students performed extremely well in the form board, quite well in recognition of numerical patterns and poorly on card rotations.

Hypothesis 3. - Cognitive Domain - Achievement

Five subscores were utilized from results of the California Test of Basic Skills - Computation, Concepts, Application, Total, and Graphing Skills. At some lower levels, graphing was measured as part of one subtest - Study Skills.

These tests are routinely administered to all District students in May of each year. Different levels of different difficulty are administered for different grade levels. Comparison of raw scores for pre- and post-measure is valid only for grade levels where students took the same form the previous year. This applied to only two grade levels 4 and 6. For these two grades, t-tests were conducted and are shown in tables 16 and 17.

At grade 4 all means for each subtest for both categories - average ability and low ability - increased significantly at the 5% level of confidence. Six were significant at the .1% level. The least significant progress was in graphing skills for 17 low ability students.

At grade 6 gains for each subtest for each ability level were noted, but not all were significant. For students with average or low ability, gains were significant at the .1% level except for concepts for the low ability students which was significant at the 1% level. Gains for 32 high ability students were significant at the 5% level only for application and graphing.

Hypothesis 3 is therefore substantiated.

Table 16. Change in CTBS Achievement Raw Scores for MICA Students, 1972-73, Grade 4

Level	Subtest	Mean - Pre	Mean - Post	Diff	t	df	Growth in Grade Equivalent
Aver.	Computation	47	53	5.5	4.00***	48	.3
	Concepts	19	23	4.2	7.32***	48	-.2
	Application	13	14	1.2	2.64**	48	.1
	Total	79	90	10.9	6.48***	48	.5
	Graphing	19	23	3.5	2.64**	48	.8
Low	Computation	33	46	13.2	7.74***	16	.5
	Concepts	12	17	4.7	4.02***	16	.6
	Application	6	9	3.2	3.32**	16	.7
	Total	52	73	21.1	8.55***	16	.5
	Graphing	12	14	2.7	2.54*	16	.4

* Significant at 5% on a one-tailed test

** Significant at 1% on a one-tailed test

*** Significant at .1% on a one-tailed test

Table 17. Changes in CTBS Achievement Raw Scores for MICA Students, 1972-73, Grade 6.

Level	Subtest	- Mean - Pre	Post	Diff	t	df	Change in Grade Equivalent
High	Computation	40	41	.4	.27	31	.2
	Concepts	25	26	1.1	1.37	31	.4
	Application	15	16	1.2	2.11*	31	.6
	Total	80	82	2.7	.33	31	.4
	Graphine	25	26	1.5	2.01*	31	1.0
Average	Computation	36	42	5.7	8.52***	48	1.5
	Concepts	21	24	3.4	6.33***	48	1.1
	Application	12	14	2.3	4.32***	48	.8
	Total	69	80	11.4	8.53***	48	1.2
	Graphing	19	23	4.0	5.25***	48	1.2
Low	Computation	38	41	3.2	4.03***	50	.7
	Concepts	22	24	2.0	3.43**	50	.7
	Application	13	15	1.9	6.19***	50	.9
	Total	72	80	7.1	5.37***	50	.9
	Graphing	21	24	2.2	5.51***	50	1.2

* Significant at 5% on a one-tailed test

** Significant at 1% on a one-tailed test

*** Significant at .1% on a one-tailed test

Hypothesis 3 is further substantiated by Table 18, which shows grade equivalent growth for experimental students. Results for grades 5 and 7 were added since comparisons of grade equivalent results for different levels of the same CTBS battery were considered valid.

Of 40 measures of change, by ability level for each grade for each subtest, growth was noted in all but two - concepts for 49 average fourth graders, and concepts for 15 average ability seventh graders.

Table 18. Changes in Mean Scores in Grade Equivalents from Pre- to Post as Measured by CTBS, Spring 1972 and Spring 1973

Grade	Class Ability	n	- Subtest - Computation	Concepts	Application	Total	Graph Sk
4	Average	49	.3	-.2	.1	.5	.8*
	Low	17	.5	.6	.7	.5	.4*
	District	447	.5	.8	.7	.6	1.0*
5	High	31	2.2	1.0	.8	1.2	2.7*
	Low	44	.6	1.1	.9	.7	1.0*
	District	452	.7	.7	.8	.8	.6*
6	High	32	.2	.4	.6	.4	1.0
	Average	49	1.5	1.1	.8	1.2	1.2
	Low	51	.7	.7	.9	.9	1.2
	District	494	.5	.9	.4	.6	.0
7	Average	15	.2	-.2	.5	.1	.2
	District	450	-.1	-.1	-.4	.0	-.4

* Total Study Skills

Hypothesis 4. - Cognitive Doman - Achievement.

Progress in achievement however, is routinely expected, especially over a years' time. Comparisons were therefore made with district means. Significant differences were not really anticipated because of the MICA influence on all teachers. Results that were at least equal, allowing for statistical errors, however, might be reasonably expected.

Comparisons are made in Table 18 with district mean changes. Caution must be exercised in that the MICA students may not be representative of students at that grade level.

In grade 7, MICA students improved more than district means except in concepts.

In grade 6, growth in graphing skills for MICA students was over one grade equivalent higher than district growth; application means also grew consistently higher than average district means. By ability level, average students grew substantially faster than the district average on all categories. Low ability MICA sixth graders showed higher growth than the district average in all but concepts. However, high ability students grew less than the district average on computation and concepts.

In grade 5, gains by 31 high ability MICA students far surpassed district average growth on all categories except application which was comparable. Strengths were graphing and computation. Growth for 44 low ability students was either comparable or higher than district average growth.

In grade 4, gains by 49 average ability MICA students were less than district average gains in all categories. Gains by 17 low ability MICA students surpassed those of MICA average ability students and were comparable to average district gains except in graphing skills.

Overall, growth in MICA students appears better than district growth.

Hypothesis 4 would therefore appear to be substantiated in general, although statistical tests were not conducted.

The CTBS test results yield another measure of achievement that incorporates some comparability. Anticipated achievement as well as actual achievement scores are generated if students simultaneously take the aptitude test, one of the measures of projected achievement. Conrad Area administered the aptitude test only in grade 3. Results are shown in Table 19. In all cases except one, means of actual achievement of MICA students exceeded anticipated means. The actual computation mean of one teacher, .04 grade equivalents below that predicted, was the one exception. Others range from .03 grade equivalents higher to .60 grade equivalents higher (in concepts). Differences for these individual classes

Table 19. Comparison of the Difference Between Mean Actual Grade Equivalent and Anticipated Grade Equivalent, CTBS, Grade 3, 1972-73, for MICA teachers, school, district.

Unit	Mean of Actual Grade Equiv. - Anticipated Grade				
	n	Comp.	Conc.	App.	Total Math	Study Skill
District	437	.2	.2	.1	.2	.1
Spruce Elem	186	.1	.2	.0	.1	.1
MICA Teacher 1		-.04	.27	.14	.03	.05
Rich Park Elem	103	.3	.4	.1	.3	.0
MICA Teacher 1		.28	.60	.27	.35	.19
MICA Teacher 2		.27	.53	.44	.36	.12

can also be compared to school and district differences. In computation, school and district "overachievement" from anticipated means was greater than that of MICA classes. In concepts and application, MICA classes exceeded predictions more than school and district means. In total math scores and study skills, two of the three classes exceeded anticipated scores more than did school and district means. As previously indicated, these measures reflect ability levels. These results again indicate favorable achievement scores for MICA students.

A bridge class between grades 1 and 2 had been tested at the end of the year and the end of the previous year on the Wide Range Achievement Test. Results are tallied on Table 20, which shows that the class, while generally immature, showed development in mental age of well over 1 year.

Grade equivalent achievement means for classes of MICA students are displayed in Tables 21, 22, 23 along with school and district means. These means however do not reflect ability levels. MICA students therefore cannot be considered representative. As a result, some MICA class means are higher and some lower than school and district means.

Hypothesis 5. Creativity.

Students in the program were expected to improve their creativity. Table 24 summarized results on the figural form and Table 25 summarizes results on the verbal form.

Of the four measures on the figural test, two improved and two deteriorated. One of each was consistant and significantly changed (at the .1% level of confidence.) Originality improved substantially but elaboration (attention to detail) decreased significantly.

On the verbal battery, the n is limited (to 39 total) but results are generally in the favorable direction and many are significant at the 1% and .1% levels. Improvements in originality and flexibility are significant at the .1% level; in fluency at the 1% level. By category of student the high ability level fifth graders showed the greatest improvement. The average ability third graders displayed the least change - essentially no change.

Overall, especially on the basis of the verbal battery, the hypothesis on creativity was substantiated.

Conclusions are however, limited. The publisher indicates comparisons of the two forms are valid only when using standard scores. Comparisons were conducted on raw scores.

Table 20. Growth in Mental Age and DIQ of Bridge Class, Grade 1 to Grade 2, of MICA Students from 1971-72 to 1972-73

Student	DIQ 71-72	DIQ 72-73	Growth in Mental Age
1	90	118	2 yr. 6 mo.
2	109	111	1 yr. 4 mo.
3	102	107	1 yr. 6 mo.
4	103	107	1 yr. 5 mo.
5	-	106	2 yr. 10 mo.
6	99	104	1 yr. 1 mo.
7	110	104	6 mo.
8	-	102	-
9	87	100	2 yr. 3 mo.
10	94	100	1 yr. 6 mo.
11	83	100	2 yr. 2 mo.
12	88	96	1 yr. 3 mo.
13	98	94	8 mo.
14	95	93	10 mo.
15	88	92	1 yr. 2 mo.
16	86	91	1 yr. 2 mo.
17	100	91	3 mo.
18	86	90	1 yr. 0 mo.
19	98	89	3 mo.
20	73	77	1 yr. 11 mo.
21	90	79	0
22	90	-	-

Table 21. Comparison of CTBS Means for MICA Teachers, School, and District Results, Grade 3, 1972-73

Unit	n	Mean in Grade Equivalent				
		Comp.	Conc.	App.	Tot. Math	Study Skills
District	437	4.1	4.3	4.0	4.1	4.3
Spruce Elem.	186	4.0	4.2	4.0	4.0	4.4
MICA teacher		3.7	4.0	3.8	3.7	3.9
Rich Park Elem	103	4.3	4.5	4.0	4.3	4.4
MICA teacher 1		4.2	4.7	4.2	4.3	4.4
MICA teacher 2		4.2	4.6	4.4	4.3	4.4

Table 22. Comparison of CTBS Means for MICA Teachers, School, and District Results, Grade 4, 1972-73

Unit	n	Mean in Grade Equivalent				
		Comp.	Conc.	App.	Tot. Math	Study Skills
District	447	4.7	5.1	4.8	4.8	5.1
Spruce Elem.	173	4.7	5.2	4.7	4.9	5.2
MICA teacher	25	4.3	4.7	4.0	4.3	4.2
Rich Park Elem	119	4.6	4.7	4.5	4.6	4.5
MICA teacher	17	4.0	3.6	3.1	3.8	3.2
Krebs Elem	155	4.8	5.2	5.1	4.9	5.4
MICA teacher	24	4.9	5.6	5.0	5.1	5.5

Table 23. Comparison of CTBS Means for MICA Teachers and District Results, Grades 5,6,7

Unit	n	Raw Score Mean					Grade Equiv. Mean				
		Comp.	Conc.	App.	Math Total	Graph	Comp.	Conc.	App.	Math Total	Graph
Grade 7											
District	450	29.2	18.4	11.5	59.1	14.5	6.9	7.0	6.5	6.9	7.0
Rich Park Jr High	178	28.9	17.5	10.5	56.9	13.5	6.7	6.6	6.1	6.7	6.2
MICA Teacher	15	26.0	15.1	10.3	51.5	11.5	6.3	5.8	6.1	6.2	5.9
Grade 6											
District	495	40.3	23.6	14.1	78.0	23.5	6.4	7.1	6.4	6.6	6.6
Spruce Elem	223	39.8	23.4	13.9	77.2	22.7	6.1	6.8	6.0	6.5	6.3
MICA Teacher 1 av.	22	42.3	25.0	13.7	81.0	22.5	7.1	7.4	6.4	7.0	6.7
MICA Teacher 2 av.	27	41.5	23.9	13.9	79.3	23.3	7.1	7.1	6.4	6.7	6.7
MICA Teacher 3 low	23	35.5	18.6	10.1	64.2	18.0	5.6	5.4	5.0	5.3	5.2
Krebs Elem	175	41.2	24.1	14.8	80.1	24.7	6.6	7.1	6.4	6.9	7.1
MICA Teacher 1 hi	32	40.6	25.6	16.2	82.4	26.2	6.6	7.8	7.5	7.1	8.7
MICA Teacher 2 low	28	45.3	28.4	18.6	92.2	23.7	8.6	8.9	9.8	9.0	7.1
Grade 5											
District	452	36.1	20.7	11.6	68.6	20.1	5.6	6.0	5.6	5.7	5.7
Spruce Elem	223	39.8	23.4	13.9	77.2	22.7	6.1	6.8	6.0	6.5	6.3
MICA Teacher 1 hi	31	42.5	26.6	16.9	86.0	26.1	7.1	8.4	8.2	7.7	8.7
MICA Teacher 2 low	44	30.1	16.4	7.5	54.0	15.2	4.8	4.7	4.4	4.7	4.6

Table 24. Changes in Mean t-Scores of Figural Measures for MICA Students, 1971-72

Test Scoring Category	Change in Mean Raw Score for Grade				
	Average 3 n=17	Low 5 n=15	High 5 n=17	EMR n=6	Total n=55
Fluency	.9	2.1	-2.9	-6.8*	-.8
Flexibility	1.0	4.4	-.1	-3.7	1.1
Originality	2.9	27.1***	22.1***	22.8*	17.6***
Elaboration	-11.6***	-12.6***	-13.6***	-10.3*	-12.2***

* Significant at 5% on a one-tailed test

** Significant at 1% on a one-tailed test

*** Significant at .1% on a one-tailed test

Table 25. Changes in Mean Raw Scores of Verbal Creativity Measures for MICA Students, 1971-72

Test Scoring Category	Change in Mean Raw Score for Grade: Average 3 n=16	Low 5 n=8	High 5 n=15	Total n=39
Flexibility				
4	-.5	1.3	.1	.1
5	.8	2.3*	5.5***	2.9***
Total	.3	3.5*	5.6***	3.0***
Fluency				
4	-.7	2.9	2.7	1.4
5	-.5	5.8	14.6**	6.6**
6	.6	.4	18.7***	7.5**
Total	-.7	9.0	36.0**	15.4**
Originality				
4	-.3	.9	.9	.4
5	.8	1.8	12.6***	5.5***
6	.0	-1.0	-.7	-.5
Total	.4	1.6	12.9***	5.5***

* Significant at 5% on a one-tailed test

** Significant at 1% on a one-tailed test

*** Significant at .1% on a one-tailed test

Cognitive Domain - Achievement - Criterion Referenced.

Behavioral objectives were selected and/or developed by MICA teachers in the 1972 workshop. These were used as criterion - referenced measures. Teachers were asked to determine the percentage of children who could achieve the objective at the beginning of the year and at the end of each marking period. The objectives developed, are summarized in the separate publication, Behavioral Objectives for Criterion - Referenced Evaluation Measures and are listed in Tables 27,29,31,33,35,37,39 and 41.

Results for grades K-6 are summarized in Tables 26,28, 30,32,34,36,38,40. With the exception of the Bridge Class between grades 1 and 2 and one kindergarten class, progress can be seen for almost all objectives for each grade level. Results are erratic, as can be expected. Drops sometimes occur after a peak in the middle of the year, probably after the topic was emphasized. The data from grades 3,5, and 6 were graphed in Figures 3,4,5 in order to more visually display the typical results. Review of the data would again confirm that substantial improvements of achievement were attained by MICA teachers. Since standards were not always established, criterion measures on these bases were not possible. In general, data further substantiate Hypothesis 3, that students would improve in achievement.

Table 26. Percentage of Students in Primary EMR Class Able to Perform the Respective Behavioral Objectives, 1972-73

Objective	Percentage Performing Objective in October n=11	January n=11	March n=11	Final n=11
1a	36	100	91	91
1b	9	55	91	91
1z	0	36	91	91
1d	0	27	91	91
2a	45	91	91	91
2b	0	64	91	91
2z	0	27	91	91
2d	0	18	91	91
3a	55	55	82	82
3b	0	45	55	55
4a	0	55	100	100
4b	9	64	91	91
4z	0	27	91	91
4d	0	100	45	45
4e	100	91	100	100
4f	100	100	100	100
4g	82	73	100	100
4h	0	0	91	91
4z	0	0	82	91
5a	9	82	91	91
5b	0	45	82	82
5z	0	64	82	82

Table 27. Primary EMR Objectives Used for Criteria - Referenced Measures, 1972-73

1. Using abaci, math balances, Stern materials, or popsicle sticks, the pupil will add two numbers whose sum is equal to or less than: (a) 20; (b) 30; (c) 40; (d) 50.

2. Using abaci, math balances, Stern materials, or popsicle sticks, the pupil will find the difference between two numbers when the when the subtrahend is equal to or less than: (a) 20; (b) 30; (c) 40; (d) 50.

3. The pupil (a) will be able to correctly reproduce on geodot paper the figure he has made on the geoboard, and (b) he will be able to construct on the geoboard the figure represented on geo-dot paper.

4. The pupil can construct the following curves: (a) open; (b) closed; (c) simple; (d) complex; (e) triangular; (f) square; (g) rectangular; (h) pentagonal; (i) hexagonal.

5. Given a fractional piece of a circle or square or triangle, the pupil will be able to assemble the whole using equal units and will name the fractional unit used. When the fractional unit is (a) one half,(b) one fourth, (c) one third.

Table 28. Percentage of 20 Students Achieving Objective, Bridge Class for Grade 1 to 2, 1972-73

Objective	Percentage Achieving Objective at End Of Period 1	Period 2
1	35	71
2	100	95
3	85	57
4	100	100
5	95	100
6	85	76
7	90	95
8	100	100

Table 29. Behavioral Objective for Bridge Class, Grade 1 to Grade 2 Used for Criterion-Referenced Measures, 1972-73

1. Given a clock face indicating a time to the hour or half-hour, or an illustration thereof, the student can read orally and can write the time shown.

2. Given a grid, or chart or graph with a 10 x 10 array of spaces, the student can write the numerals for 1 to 100.

3. Given a group of shapes or figures, the student can identify orally those that are circles, squares, rectangles, triangles, or parallelograms.

4. Given the addition combinations with sums up to ten, the student can produce the correct sum orally and in writing.

5. Given the subtraction combinations for which the subtrahend and minuend are ten or less, the student can produce the correct difference orally and in writing.

6. Given a series of numbers, up to 20 with differences of 2 between elements of the series, and with some elements in the series indicated as omitted, the student can recognize the pattern and fill in the missing members of the series.

7. Given a series of numbers, up to 100 with differences of 5 between elements of the series indicated as omitted, the student can recognize the pattern and fill in the missing members of the series.

8. Given a series of numbers, up to 100 with differences of 10 with differences of 10 between elements of the series, and with some elements in the series indicated as omitted, the student can recognize the pattern and fill in the missing members of the series.

Table 30. Percentage of 34 Students in Grade 3 Achieving Respective Objectives, 1972-73

Objective	Percentage Achieving Objective at End of Pretest	Period 2	Period 3	Period 4
1	0	97	100	100
2	0	88	97	100
3	50	71	68	97
4	41	79	97	100
5	41	73	82	97
6	0	100	100	100
7	0	85	100	100
8	0	62	100	100
9	35	82	100	100
10	0	35	76	88

Table 31. Grade 3 Behavioral Objectives Used for Criterion-Referenced Measures, 1972-73

1. Given a set of objects, the student can describe in writing two subsets of the given set.

2. Given any number less than 100,000, the student can read the number aloud correctly.

3. Given a region divided into a maximum of 8 congruent regions, some of which are shaded, the student can identify the fractional number associated with the shaded portion.

4. Given 2 numbers less than 1,000 where regrouping is required at most from the ones to the tens and the tens to the hundreds, the student can write the sum.

5. Given any two numbers less than 1,000 where regrouping is required at most from the tens to the ones and the hundreds to the tens, the student can write the difference.

6. Given any 2 numbers, one of which is less than 10 and the other is less than 13, the student can write the product using horizontal or vertical notation.

7. Given a 2-digit number, the student can multiply by a 1-digit number using a manipulative material and write the product.

8. Given any written amount of money less than or equal to $100.00, the student can show the same amount in play dollars and coins.

9. Shown a certain time in any 5-minute multiple on the clock, the student will write the correct time in standard form.

10. The child can complete the following table:

____ inches = 1 foot

____ feet = 1 yard

____ inches = 1 yard

PERCENTAGE OF STUDENTS ACHIEVING RESPECTIVE OBJECTIVES, GRADE 3 1972-72

Approximate N = 34

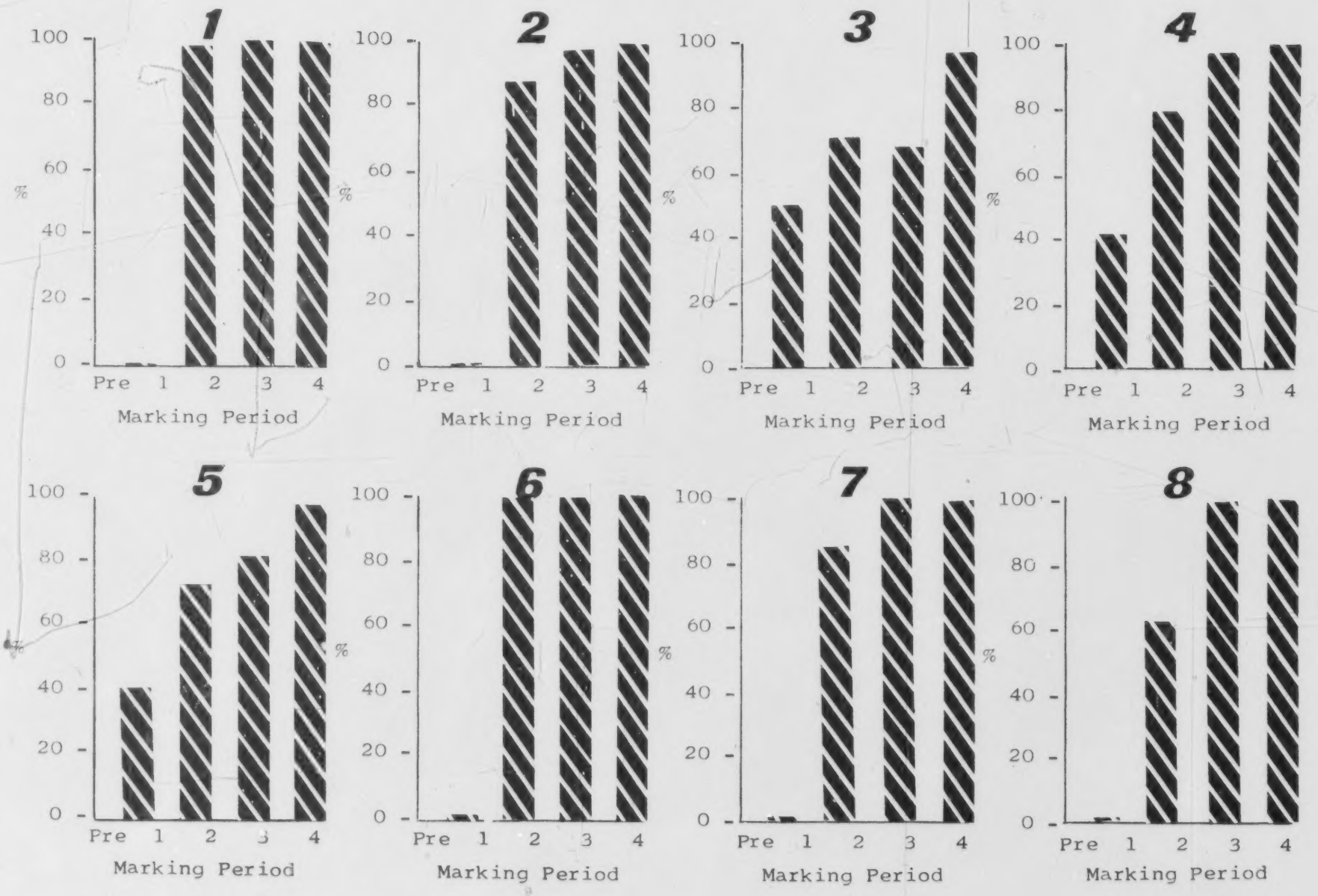


FIGURE 3- cont'd.

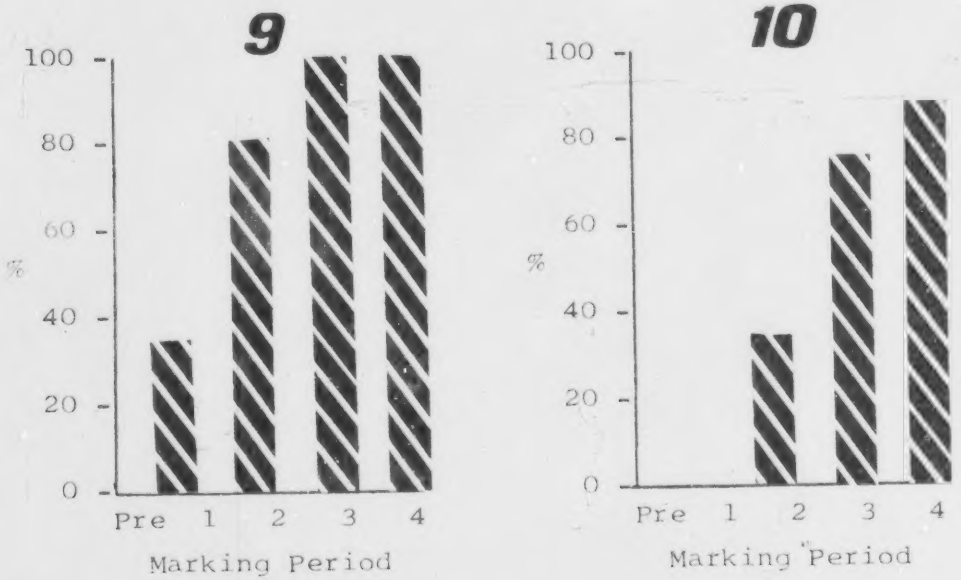


Table 32. Percentage of Students in Grade 5 Able to Perform the Respective Behavioral Objectives, 1972-73, Allowing Partial Credit for Each of Form Test Items for Each Objective

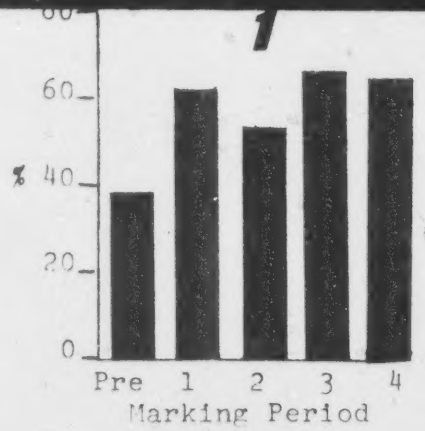
Objective	Percentage Performing Objective at End of				
	Pretest n=82	Period 1 n=77	Period 2 n=76	Period 3 n=78	Period 4 n=79
1	37	62	53	66	66
2	77	76	90	83	88
3	40	27	40	65	70
4	65	64	76	81	84
5	24	51	21	82	78
6	50	58	58	46	64
7	16	17	38	39	71
8	17	27	42	49	49
9	33	40	49	66	62
10	43	33	38	31	45

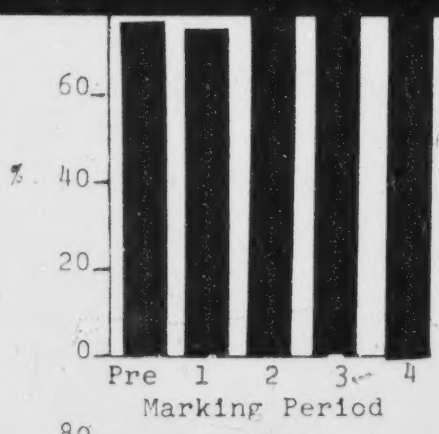
Table 33. Grade 5 Behavioral Objectives Used for Criterion-Referenced Measures, 1972-73

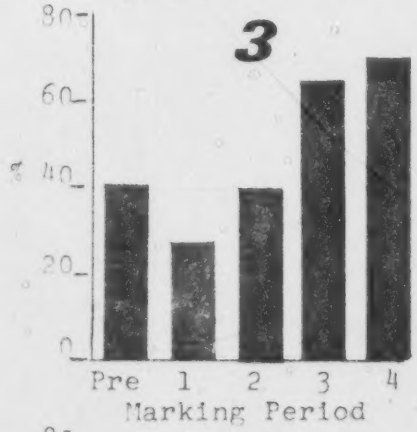
1. Given a nine-digit numeral, the student will name the place value for each group of 3 digits.
2. The student can write the sum when adding at most 5 addends each consisting of at most 5 digits.
3. The student can write the sum of any two numbers of arithmetic using fractional numerals or mixed numerals and name the sum in simplest form.
4. The student can write the difference between a subtrahend and minuend, each consisting of at most 5 digits.
5. The student can subtract one number in arithmetic from another, using fractional numerals or mixed numerals and simplify the answer.
6. The student can write the product of 2 factors consisting of at most 4 digits in the multiplicand and 3 digits in the multiplier.
7. The student can write the product of any two numbers of arithmetic using fractional numerals.
8. The student can write the quotient and remainder of a division problem involving at most a two-digit divisor and five-digit dividend.
9. Given specific time in hours and minutes in a word problem setting, the student can name the new time or the number of hours and minutes between given times.
10. Given a specific problem in measurement (time, length, or area) the student will be able to measure with 80% accuracy.

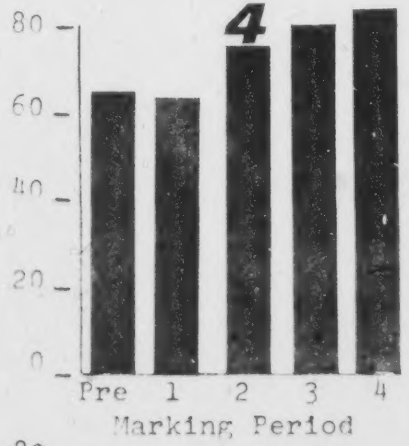
PERCENTAGE OF STUDENTS ACHIEVING
RESPECTIVE OBJECTIVES, GRADE 5*
1972-73
Approximate N = 80

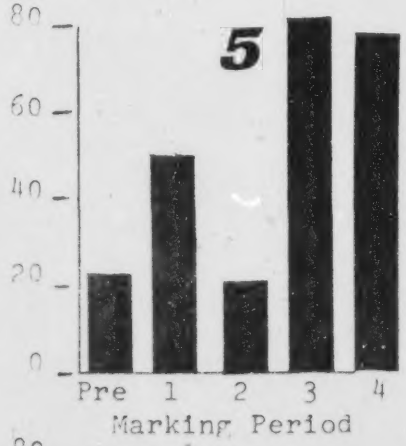
* Students were given 4 test questions per objective and counted as 1, .75, .5, .25, 0, depending on his success on the four parts

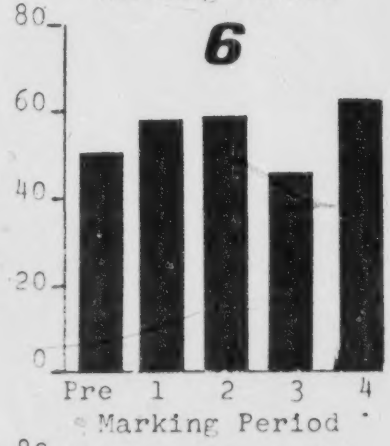


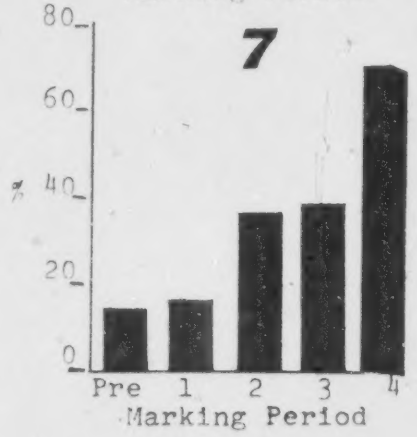


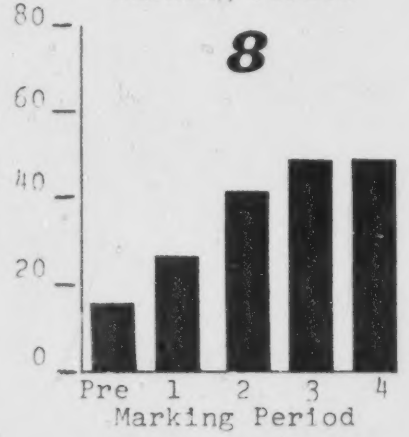


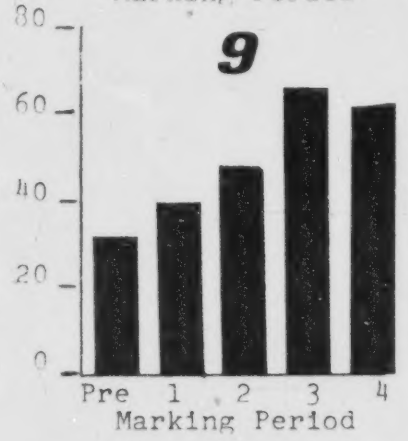












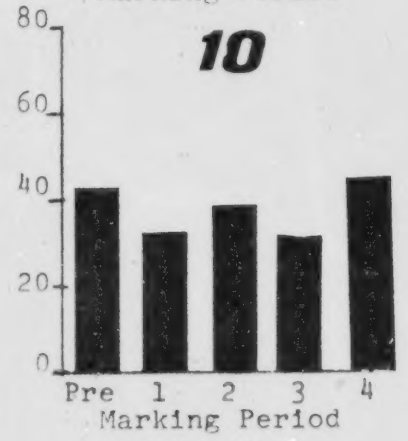


Table 34. Percentage of 49 Students in Grade 6 Achieving Respective Objectives, 1972-73

ective	Percentage Achieving Objective at End of				
	Pretest	Period 1	Period 2	Period 3	Period 4
1a	25%	61%	72%	66%	76%
b	42%	35%	49%	56%	75%
c	10%	51%	58%	81%	86%
d	10%	77%	80%	94%	80%
e	14%	72%	81%	96%	73%
f	12%	78%	78%	89%	86%
2	50%	76%	76%	84%	82%
3	46%	65%	85%	69%	66%
4	4%	45%	41%	68%	41%
5	51%	81%	80%	78%	82%
6	5%	33%	39%	54%	54%
7	27%	41%	82%	37%	64%
8	16%	15%	23%	8%	46%
9	16%	31%	50%	30%	51%
10	2%	0%	4%	6%	30%
11	24%	12%	24%	26%	50%
12a	0%	0%	0%	2%	24%
b	0%	0%	0%	2%	6%
13	27%	8%	20%	45%	19%

Table 35. Grade 5 Behavioral Objectives Used for Criterion-Referenced Measures, 1972-73

Given 4 problems relating to each of the objectives listed below, the student will correctly solve 3 out of the 4.

1.a. The student can classify sets as equal
b. The student can classify sets as equivalent
c. The student can classify sets as disjoint
d. The student can classify sets as finite
e. The student can classify sets as infinite
f. The student can classify sets as empty

2. Given at most a ten-digit numeral, the student can identify the place value of each digit.

3. Given 5 numbers of at most six digits, the student can find the sum.

4. Given 4 non-negative rational numbers written in any form, the student can find the sum.

5. Given 2 numbers of at most five digits, the student can find the difference.

6. Given 2 non-negative rational numbers written in any form, the student can find the difference.

7. Given 2 factors with at most three digits, the student can write the product.

8. Given 2 or 3 non-negative rational numbers written in any form, the student can find the product.

9. Given a division problem with a divisor less than 1,000 and a multi-digit dividend, the student can write the quotient and the remainder.

10. Given 2 non-negative rational numbers written in any form, the student can find the quotient.

11. Given the necessary information, the student can find the perimeter of any polygon.

12.a. Given the necessary information, the student will be able to find the area of a region bounded by a rectangle.

b. Given the necessary information, the student will be able to find the area of a region bounded by a square.

FIGURE 5

PERCENTAGE OF STUDENTS ACHIEVING RESPECTIVE OBJECTIVES, GRADE 6* 1972-73

Approximate N = 49

* Students were given 4 test qoestions per objective and counted as 1, .75, .50, .25, 0, depending on his success on the four problems

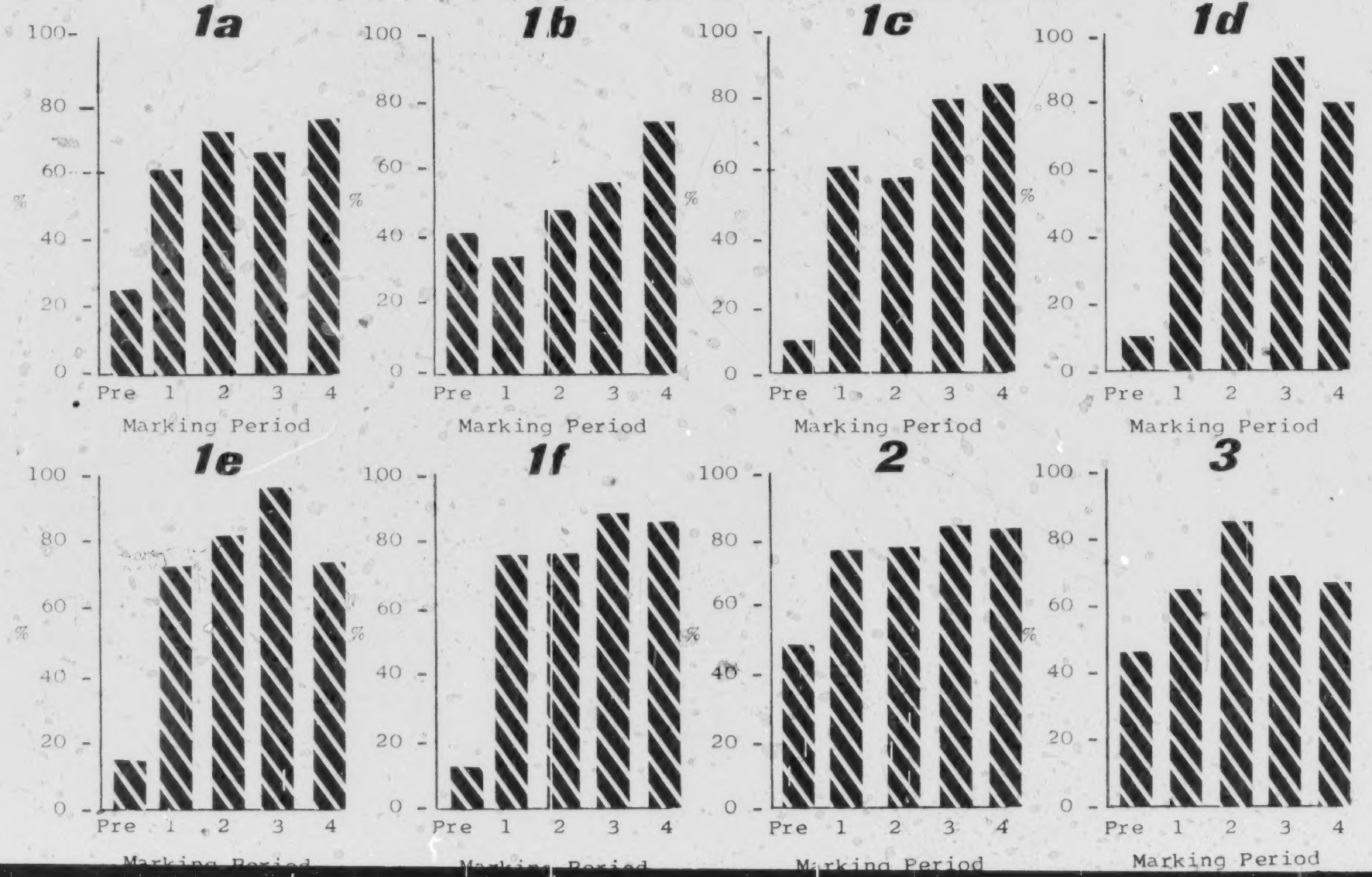


FIGURE 5 - cont'd.

Students were given 4 test questions per objective and counted as 1, .75, .50, .25, 0, depending on his success on the four problems

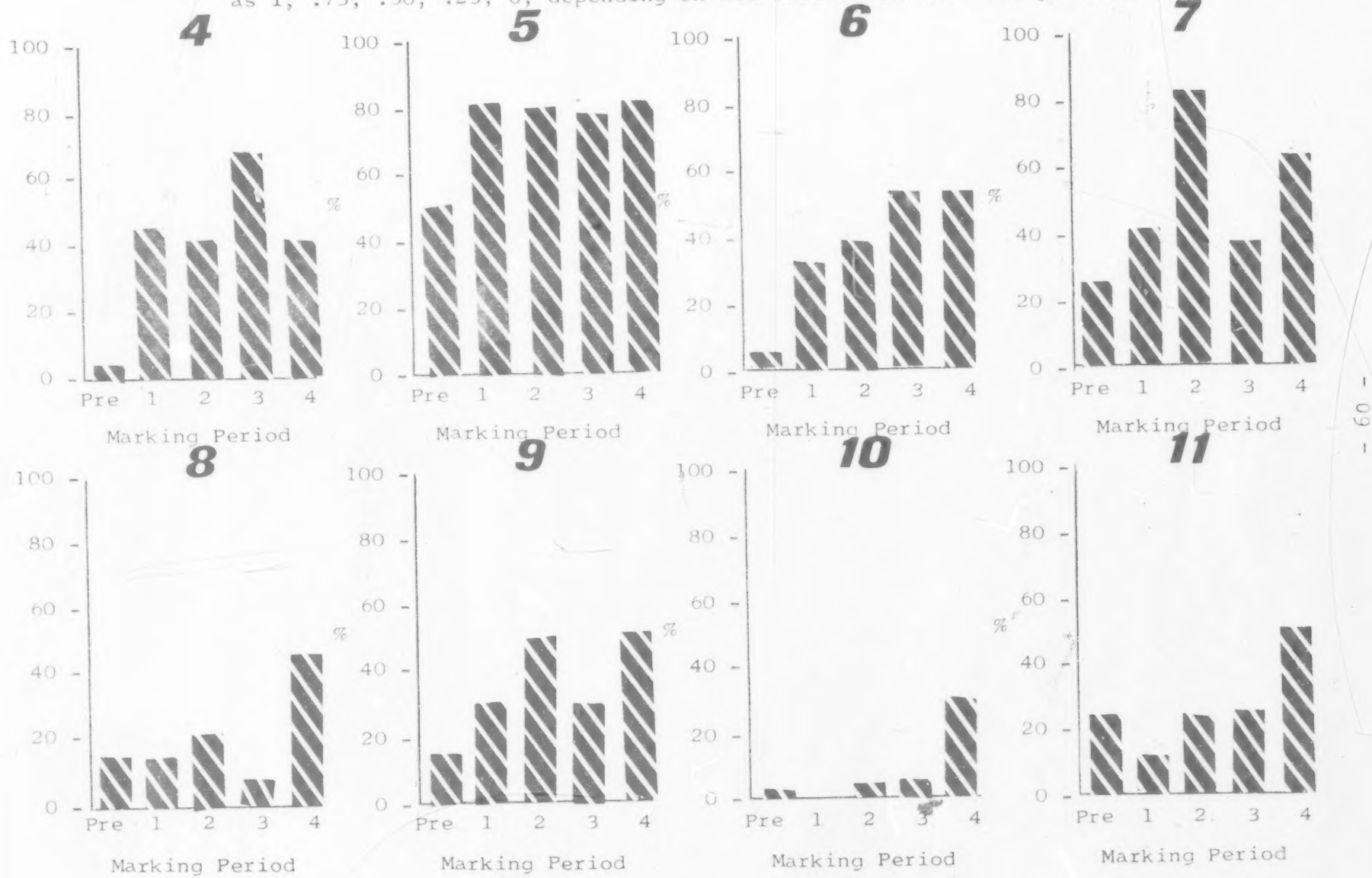


FIGURE 5 - cont'd.

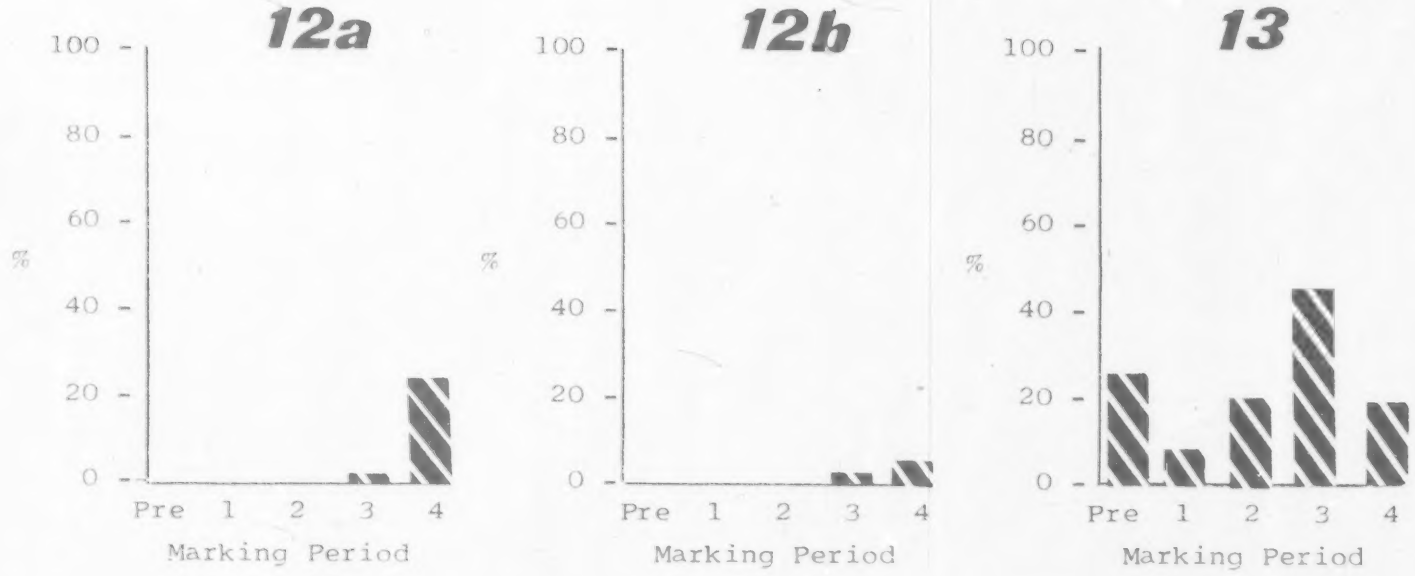


Table 36. Percentage of 33 Students in Grade 6 Achieving Modified Set of Objectives, 1972-73

Objective	Percentage Achieving Objective at End of Period 2	Period 4
1	33	81
2	51	50
3	39	44
4	18	97
5	84	87
6	51	87
7	42	75
8	12	56
9	3	53
10	0	59

Table 37. Sixth Grade Behavioral Objectives Modified for Use by Teachers whose Results Are Listed in Table 36.

1. The student can classify acts as infinite, empty, or equal.
2. Given two fractions, the students can write the product.
3. Given two fractions, the students can write the quotient.
4. Given a representation of a square and measures of the respective sides, the student can write a measure of the perimeter.
5. Given a representation of a rectangle and measures of the respective sides, the student can write a measure of the perimeter.
6. Given a representation of a square and measures of the length and width, the student can write a measure of the area.
7. Given a representation of a rectangle and measures of the length and width, the student can write a measure of the area.
8. Given a measure of the radius or diameter of a circle, the student can write a measure of the curcumference of the circle.
9. Given a measure of the radius or diameter of a circle, the student can write a measure of the area of the circle.
10. Given two numbers in decimal form with one indicated as the decimal, the student can write the quotient.

Table 38. Percentage of 45 Kindergarten Children Achieving Set 1 Objectives, 1972-73

Objective	Percentage Achieving Objective at End of Period	
	1	3
1	89	67
2	91	69
3	89	90
4	84	73
5	-	-
6	93	94
7	-	63

Table 39. Kindergarten Behavioral Objectives, Set 1, Used for Criterion-Referenced Measures, 1972-73

1. The child will be able to identify a triangle, rectangle, square and circle.

2. The child will be able to construct a triangle, square, rectangle and circle.

3. When given a set of triangles, rectangles, squares, and circles of various sizes, the child will be able to arrange the same shapes from small to large.

4. The child can identify a set as a group of objects that are alike.

5. Given some objects, the child can arrange these objects into sets.

6. The child can construct a set of one, two, three, four, five, six, seven, eight, nine and ten.

7. The children can identify the numbers 1-10.

8. The children can arrange the numbers 1-10 according to their sequential order.

9. The child can write the numbers 1-10 in their proper order.

10. Given two sets of objects, the child can identify the intersection and union of the two sets.

Table 40. Percentage of 25 Kindergarten Children Achieving Set 2 Objectives, 1972-73

Objective	Percentage Achieving Objective at End of Period		
	Pretest	1	3
1	0	0	61
2	40	54	75
3	44	50	61
4	32	33	56
5	36	38	61
6	16	50	78
7	0	0	0
8	0	0	39
9	8	21	61
10	76	79	91

Table 41. Kindergarten Behavioral Objectives, Set 2, Used for Criterion Referenced Measures, 1972-73

1. The student can identify a set and members of the set.
2. The student can construct sets of objects with a given cardinal number value between 1 and 10 inclusive.
3. The student can write any of the numerals from 1 to 10 when the numeral is named.
4. The student can order by value a penny, nickel, dime and quarter.
5. The student can order objects according to size or weight.
6. Given a set of 2-dimensional geometrical shapes, the student can identify and name: (1) circle, (2) rectangle, (3) triangle, (4) square, (5) rhombus, (6) elipse.
7. Given a set of 3-dimensional geometric solids, the student can identify and name: (1) cube, (2) cylinder, (3) sphere, (4) cone, (5) rectangular solid.
8. Given a bar graph a group of students collectively can identify which of 2 attributes occurs more frequently and can name the number of individuals with a particular attribute.
9. Given each of the following measuring devices: clock, scale, calendar, thermometer, ruler, the student can demonstrate its use.
10. Given 2 or more objects, the student can state likenesses and differences of objects.

B. Indications of data presented elsewhere, such as an appendix.

Data with respect to the evaluation of the workshop is available in a separate report, MICA 1971 Summer Workshop Report. Copies of instruments are included in the appendix.

C. Report of unanticipated outcomes.

No unanticipated results were noted other than the lack of improvement of measurable attitudes.

D. Verbal summary of results.

The verbal summary is included following each set of data where references are more readily available. In general results were favorable in achievement, pattern recognition, cognitive ability, and creativity. Improvements in attitude were unsubstantiated.

VII DISCUSSION

A. Weaknesses in the evaluation design and inconsistencies in the results.

Teachers were not randomly assigned. Experimental teachers were determined by their availability to participate in workshops. Control teachers were determined by the nature of their class assignments.

Students were not randomly assigned. Experimental students were determined by the routine student assignments to the experimental teachers.

The student population may not therefore match the normal population distribution as closely as desired.

Measures over one year do not measure longer term effects - over several years. Students are seldom retained as a group from one year to another, this preventing longitudinal measures which are expected to be more significant.

Contamination effects were evident. In many cases, experimental students had been previously influenced by MICA, possibly affecting pre-measures such as attitude to give unusually high initial scores when attitude measures are administered.

The size of the cells is less than that desired to recommended for the design used.

B. Factors that may have biased or influenced the results.

Teachers who participated in MICA and used as experimental teachers may well be biased toward teaching mathematics effectively without regard to the effect of MICA. The teacher effect is not likely to have been removed. On the other hand dissemination influences bias control teachers, making significant differences harder to realize. Tests, particularly of attitude, may not be sufficiently sensitive to measure changes.

C. Limitations of the data, especially their generalizability.

Students tested included varying grade levels and ability levels. They represent the middle and the lower middle class, an average suburban community, and are not necessarily representative of urban or the effluent suburban community.

The number of students used in creativity measures was substantially less than the number used for other measures and should be increased to improve generalizability.

D. The relationship of the major evaluation results in terms of the questions (hypotheses) and decision areas being investigated.

A summary by hypothesis is given below:

Area Measured	Hypothesis	Conclusion
1. Attitude	Students will improve.	Not substantiated
2. Cognitive ability and perception of patterns	Students will show positive change.	Substantiated. While results for classes are mixed, totals are consistently favorable.
3. Achievement	Computation and understanding of concepts will improve.	Definitely substantiated for all subtests except for high ability sixth graders.
4. Achievement	Growth will equal or surpass district growth.	Substantiated in general. Statistical tests not used.
5. Creativity	Students will improve.	Substantiated by verbal measures. Figural measures only support originality. Elaboration (detail) actually deteriorated.

E. Implications of the results in terms of past and future project operation.

Few implications have been drawn. Where hypotheses were not supported by evidence, the investigation suspects the failure was due to instruments which were not sufficiently sensitive and an insufficient sample size.

Generally the implications are to continue the program in its present format.

F. Recommendations for additional kinds of evaluation activities that were not presently possible because of funding, time, or design constraints.

Recommendations for future studies:

(1) Use longitudinal design - administer pretests well before beginning the project, administer posttests several years later.
(2) Prevent contamination on control classes for more accurate measure.
(3) Include more measures of estimation, measurement, and data analysis skills such as graphing.
(4) Further study improvements in student achievements with respect to stated behavioral objectives. (Criterion referenced measures)
(5) Use more sensitive measures in the affective domain.
(6) Use creativity measures on a larger number of students and a greater variety of grade and ability levels.
(7) Use measures of skill and accuracy in measurement.

VIII CONCLUSIONS AND RECOMMENDATIONS:

A. Summary of major findings

The MICA workshop was effective in influencing teachers to learn and use new methods and materials. Evidence was seen in analysis of pre-and post measures in the workshop as well as in tabulations of frequency of such use.

The increase in number of students to attain stated behavioral objectives was impressive.

Evidence regarding improved student ability to recognize patterns was conclusive.

Standardized achievement measures did show improvement

Verbal measures of creativity did show significant improvements. Figural measures showed substantial and significant improvements in originality but a decline in elaboration (detail in drawings).

B. Conclusions drawn from each finding in terms of the questions (hypotheses) investigated and the decisions to be made.

A summary by hypothesis is given below:

Area Measured	Hypothesis	Conclusion
1. Attitude	Students will improve.	Not substantiated
2. Cognitive ability and perception of patterns	Students will show positive change.	Substantiated. While results for classes are mixed, totals are consistently favorable.
3. Achievement	Computation and understanding of concepts will improve.	Definitely substantiated for all subtests except for high ability sixth graders.
4. Achievement	Growth will equal or surpass district growth.	Substantiated in general. Statistical tests not used.
5. Creativity	Students will improve.	Substantiated by verbal measures. Figural measures only support originality. Elaboration (detail) actually deteriorated.

C. Recommendations for future program action indicated by the findings and conclusions.

Findings generally support that Project MICA continue in its present directions.

D. Possible constraints that may influence which actions should be taken and why. These constraints may be internal or external to the projects' operation.

No particular constraints are noted.

IX. SUMMARY: PROJECT DESCRIPTION, EVALUATION PROCEDURES, MAJOR FINDINGS, AND RECOMMENDATIONS.

The purpose of Project MICA is strengthening mathematics instruction through use of a variety of teaching techniques, including small group instruction; individualized instruction; use of manipulative materials, games, and listening stations; open-ended units; estimation, collection, and graphing of data; diagnostic testing and remediation.

As a result of the use of these techniques, students were expected to improve attitudes toward mathematics, understanding of mathematics concepts, computational skill, and perception of patterns.

Major facets of the project were workshops for teachers and implementation through supply of materials and use of instructional aides.

MICA classes were administered pre- and posttests. T-tests were used in comparing changes from pre- to post in MICA classes. Attainment of performance objectives was also measured.

The direct effect of the workshop on teachers was measured by pre- and post-tests analyzed by Fisher tests. Positive effects were noted, many of which were statistically significant. Frequency counts of use of materials and techniques such as small group instruction showed notable use of such techniques.

Attainment of behavioral objectives showed impressive gains.

No significant improvement in attitudes toward mathematics was measured.

Hypotheses in greater recognition of patterns and standardized achievement measures were substantiated. While experimental students improved significantly in several measures, control students also improved.

Verbal measures of creativity did show significant gains. Figural creativity measures showed significant gains in originality and a large drop in elaboration (detail in drawings).

Of five hypotheses, four were substantiated, one was rejected.

The basic conclusion and recommendation was the continuance of the project in its present format and procedures.

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Campbell, Donald T. and Stanley, Julian C. "Experimental and Quasi - Experimental Designs for Research on Teaching." Handbook of Research on Teaching. Edited by N. L. Gage. Chicago: Rand McNally & Co., 1963.

Koch, Richard R. MICA 1972 Summer Workshop Report. Wilmington, Delaware: Conrad Area School District, December, 1972. (60 pages - mimeographed)

Koch, Richard R. Behavioral Objectives Constructed by MICA Teachers in 1972 Workshop for Criterion-Referenced Evaluation Measures. Wilmington, Delaware: Conrad Area School District, May, 1973. (18 pages - memeographed).

Credits for Use of Tests

Educational Testing Service. Kit of Reference Tests for Cognitive Factors. Letter of November 11, 1970 from Kenneth W. Buell, Assistant Editor, Office of Special Tests.

School Mathematics Study Group. Attitude Inventory. Letter of December 1, 1970 from E. G. Begle, Director.

Appendix

Sample of Locally Reproduced Tests

Name _____

Teacher _____

Student Inventory 2

1. This is not a test. There are no "right" or "wrong" answers to any of the questions. Just answer them as honestly as you can.

2. The questions ask you to tell how you feel about many different things. Your answer to each question should tell how you feel about it.

3. To answer a question, circle the answer which seems best to you.

4. Do not spend a long time on any one question. Just circle the answer that seems best to you at the moment. Please answer all items, and give only one answer to each.

5. Circle the <u>yes</u> answer if the sentence is true or right for you. Circle <u>no</u> if you do not agree. Circle <u>not sure</u> if you are not sure which way to answer. Here is an example:

   Playing outdoors is more fun than playing inside.

   [3]yes
   [2]not sure
   [1]no

   Which one of the ways tells best how <u>you</u> feel about the statement? <u>Circle the answer you choose</u>.

6. If you have any questions while you are working, just raise your hand.

7. Remember, answer all questions.

   You may begin now.

1. I like writing spelling words more than reading a story book.

1 yes
2 not sure
3 no

2. I like drawing a picture more than singing a song.

1 yes
2 not sure
3 no

3. I like writing stories more than playing games in gym.

3 yes
2 not sure
1 no

4. I like reading best.

1 yes
2 not sure
3 no

5. I like story books more than arithmetic books.

3 yes
2 not sure
1 no

6. I like doing arithmetic more than doing anything else.

1 yes
2 not sure
3 no

7. I like writing answers to social studies questions more than doing word problems in arithmetic.

3 yes
2 not sure
1 no

8. I like arithmetic books more than social studies books.

1 yes
2 not sure
3 no

9. I like subtracting numbers more than reading a story about Brazil.

1 yes
2 not sure
3 no

10. I would like to teach English more than I would like to teach arithmetic.

3 yes
2 not sure
1 no

11. Number the one you like best with 1, number the next best with 2, number the next best 3, number the one you like next best 4, number the next best 5, number the next best 6, number the next best 7, number the last one 8.

___ reading
___ art
___ music
___ arithmetic
___ social studies
___ science
___ gym
___ English

12. Science is my favorite subject in school.

[1]yes
[2]not sure
[3]no

13. I like reading in small groups.

[1]yes
[2]not sure
[3]no

14. I wish we did not have to go to gym.

[3]yes
[2]not sure
[1]no

15. I enjoy the work we do in art.

[1]yes
[2]not sure
[3]no

16. Spelling words is no fun.

[3]yes
[2]not sure
[1]no

17. The subject I like least is arithmetic.

[3]yes
[2]not sure
[1]no

18. I can not understand how some students think arithmetic is fun.

[3]yes
[2]not sure
[1]no

19. Arithmetic is boring.

[3]yes
[2]not sure
[1]no

20. Arithmetic is fun.

[1]yes
[2]not sure
[3]no

21. My spelling teacher makes spelling interesting.

[3]yes
[2]not sure
[1]no

22. Music is fun.

[1]yes
[2]not sure
[3]no

23. I find it hard to talk in front of my arithmetic class.

[3]yes
[2]not sure
[1]no

24. I am very proud of my arithmetic school work.

[1]yes
[2]not sure
[3]no

25. I try to do the very best work in arithmetic that I can.

[1]yes
[2]not sure
[3]no

26. I like to be called on in arithmetic class.

[1]yes
[2]not sure
[3]no

27. I think I am doing very well in arithmetic class.

[1]yes
[2]not sure
[3]no

28. I feel upset in arithmetic class.

[3]yes
[2]not sure
[1]no

29. My math teacher makes me feel that I am doing poorly.

[3]yes
[2]not sure
[1]no

30. I am discouraged with my arithmetic school work.

[3]yes
[2]not sure
[1]no

31. I work very hard in art class.

[1]yes
[2]not sure
[3]no

32. I cannot play the games in gym.

[3]yes
[2]not sure
[1]no.

33. I like to show people the things I make in art.

[3]yes
[2]not sure
[1]no

34. I do not do well in spelling.

[1]yes
[2]not sure
[3]no

35. I like doing arithmetic by myself.

[3]yes
[2]not sure
[1]no

36. I like working in small groups without teacher help.

[3]yes
[2]not sure
[1]no

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Name _____

Teacher _____

Student Inventory B

1. This is not a test. There are no "right" or "wrong" answers to any of the questions. Just answer them as honestly as you can.

2. The questions ask you to tell how you feel about many different things. Your answer to each question should tell how you feel about it. Ignore the little numbers. They simply number the answers and are sometimes mixed up.

3. To answer a question, circle the answer which seems best to you.

4. Please work carefully and quickly. Do not spend a long time on any one question. Just mark the answer that seems best to you at the moment. Please answer all the items, and give only one answer to each.

5. Some questions have a blank space in the middle. Different ways to fill the blank space are given beneath each sentence. Here is an example:

   I like summer _____ than winter.

   [1] a lot more
   [2] a little more
   [3] a little less
   [4] a lot less

   Which one of the four ways tells best how you like summer as compared with winter: Circle the answer you choose.

6. For other questions you are just to tell how you feel about each statement by selecting one of the ways given beneath the statement. Here is an example:

   It is more fun to play outdoors in winter than in summer.

   [4] strongly agree
   [3] agree
   [2] disagree
   [1] strongly disagree

   Which one of the ways tells best how you feel about the statement: Circle the answer you choose.

7. If you have any questions while you are working, raise your hand.

8. There is no time limit for these questions. When you finish all the questions would you please check to see that you have answered each question and be sure that you have marked only one answer for each one.

 You may begin now.

1. I like social studies _____ than science.

   1 a lot more
   2 a little more
   3 a little less
   4 a lot less

2. I enjoy writing stories in English class _____than drawing a picture in art.

   4 a lot more
   3 a little more
   2 a little less
   1 a lot less

3. I enjoy reading short stories _____ than listening to marches in music class.

   1 a lot more
   2 a little more
   3 a little less
   4 a lot less

4. I like studying maps in geography _____ than studying grammar in English.

   4 a lot more
   3 a little more
   2 a little less
   1 a lot less

5. I like story books _____ than arithmetic books.

   4 a lot more
   3 a little more
   2 a little less
   1 a lot less

6. I like doing arithmetic _____ than doing anything else.

   1 a lot more
   2 a little more
   3 a little less
   4 a lot less

7. I like writing answers to social studies questions _____ than doing word problems in arithmetic.

   4 a lot more
   3 a little more
   2 a little less
   1 a lot less

8. I like arithmetic books _____ than social studies books.

   1 a lot more
   2 a little more
   3 a little less
   4 a lot less

9. I like subtracting fractions _____ than reading a story about Brazil.

   1 a lot more
   2 a little more
   3 a little less
   4 a lot less

10. I would like to teach English _____ than I would like to teach arithmetic.

    4 a lot more
    3 a little more
    2 a little less
    1 a lot less

11. For most jobs it is more important to be well rounded and broadly educated than to know arithmetic.

5 strongly agree
4 agree
3 don't know
2 disagree
1 strongly disagree

12. Except for those who are going to be scientists or engineers most students would rather take other courses than mathematics.

5 strongly agree
4 agree
3 don't know
2 disagree
1 strongly disagree

13. Rank in the order you like them. Number the one you like best with 1, the next best with 2, and so on. The last one should be numbered 8.

___ reading
___ art
___ music
___ mathematics
___ social studies
___ science
___ gym
___ English

14. I would like to teach music more than I would like to teach gym.

1 strongly agree
2 agree
3 don't know
4 disagree
5 strongly disagree

15. Most students would rather not take music unless they are going to be musicians.

5 strongly agree
4 agree
3 don't know
2 disagree
1 strongly disagree

16. The subject I enjoy most is art.

1 strongly agree
2 agree
3 don't know
4 disagree
5 strongly disagree

17. The subject I enjoy least is arithmetic.

5 strongly agree
4 agree
3 don't know
2 disagree
1 strongly disagree

18. I can not understand how some students think arithmetic is fun.

5 strongly agree
4 agree
3 don't know
2 disagree
1 strongly disagree

19. Arithmetic is boring.

5 strongly agree
4 agree
3 don't know
2 disagree
1 strongly disagree

20. Arithmetic is fun.

1 strongly agree
2 agree
3 don't know
4 disagree
5 strongly disagree

21. Science is fun.

1 strongly agree
2 agree
3 don't know
4 disagree
5 strongly disagree

22. Music is boring.

5 strongly agree
4 agree
3 don't know
2 disagree
1 strongly disagree

23. I enjoy reading stories aloud in front of my English class.

1 strongly agree
2 agree
3 don't know
4 disagree
5 strongly disagree

24. I would rather play by myself than with others during recess.

1 strongly agree
2 agree
3 don't know
4 disagree
5 strongly disagree

25. I find it hard to talk in front of my arithmetic class.

6 strongly agree
5 agree
4 mildly agree
3 mildly disagree
2 disagree
1 strongly disagree

26. I am very proud of my arithmetic school work.

1 strongly agree
2 agree
3 mildly agree
4 mildly disagree
5 disagree
6 strongly disagree

27. I try to do the very best work in arithmetic that I can.

1 strongly agree
2 agree
3 mildly agree
4 mildly disagree
5 disagree
6 strongly disagree

28. I like to be called on in arithmetic class.

1 strongly agree
2 agree
3 mildly agree
4 mildly disagree
5 disagree
6 strongly disagree

29. I think I am doing very well in arithmetic class.

1 strongly agree
2 agree
3 mildly agree
4 mildly disagree
5 disagree
6 strongly disagree

30. I feel upset in arithmetic class.

6 strongly agree
5 agree
4 mildly agree
3 mildly disagree
2 disagree
1 strongly disagree

31. My math teacher makes me feel that I am doing poorly.

6 strongly agree
5 agree
4 mildly agree
3 mildly disagree
2 disagree
1 strongly disagree

32. I am discouraged with my arithmetic school work.

6 strongly agree
5 agree
4 mildly agree
3 mildly disagree
2 disagree
1 strongly disagree

3. I work the very best I can in social studies.

[1]strongly agree
[2]agree
[3]mildly agree
[4]mildly disagree
[5]disagree
[6]strongly disagree

4. I am unhappy about my work in English class.

[6]strongly agree
[5]agree
[4]mildly agree
[3]mildly disagree
[2]disagree
[1]strongly disagree

5. I enjoy small reading groups rather than reading in front of a class.

[1]strongly agree
[2]agree
[3]mildly agree
[4]mildly disagree
[5]disagree
[6]strongly disagree

6. I am proud of the work I'm doing in science.

[6]strongly agree
[5]agree
[4]mildly agree
[3]mildly disagree
[2]disagree
[1]strongly disagree

7. My art teacher makes me feel proud of my art work.

[1]strongly agree
[2]agree
[3]mildly agree
[4]mildly disagree
[5]disagree
[6]strongly disagree

38. I like reading on my own rather than reading aloud as a class.

[1]strongly agree
[2]agree
[3]mildly agree
[4]mildly disagree
[5]disagree
[6]strongly disagree

39. I have trouble doing things in gym.

[6]strongly agree
[5]agree
[4]mildly agree
[3]mildly disagree
[2]disagree
[1]strongly disagree

40. I like using activity cards.

[5]agree strongly
[4]agree
[3]don't know
[2]disagree
[1]disagree strongly

41. I like doing mathematics by myself.

[5]agree strongly
[4]agree
[3]don't know
[2]disagree
[1]disagree strongly

42. I like working in small groups without teacher help.

[5]agree strongly
[4]agree
[3]don't know
[2]disagree
[1]disagree strongly

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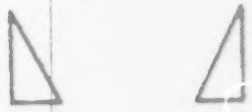
Name: _____

CARD ROTATIONS -- S-2

This is a test of your ability to see differences in figures. Look at the 5 triangle-shaped cards drawn below.

All of these drawings are of the same card, which has been slid around into different positions on the page.

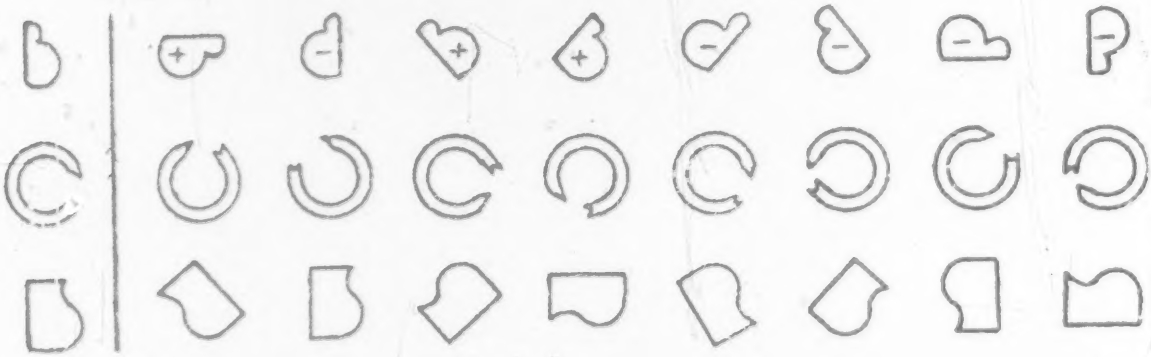
Now look at the 2 cards below:



These two cards are not alike. The first cannot be made to look like the second by sliding it around on the page. It would have to be flipped over or made differently.

Each problem in this test consists of one card on the left of a vertical line and eight cards on the right. You are to decide whether each of the eight cards on the right is the same as or different from the card at the left. Put a plus (+) or cross (X) on the card, if it is the same as the one at the beginning of the row. Put a minus (—) on the card, if it is different from the one at the beginning of the row.

Practice on the following rows. The first row has been correctly marked for you.



Your score on this test will be the number of cards marked correctly minus the number marked incorrectly. Therefore, it will not be to your advantage to guess, unless you have some idea whether the card is the same or different. Work as quickly as you can without sacrificing accuracy.

You will have 4 minutes for the one page of this test. When you have finished the page, STOP. Please do not go on until you are asked to do so.

DO NOT TURN THIS PAGE UNTIL ASKED TO DO SO.

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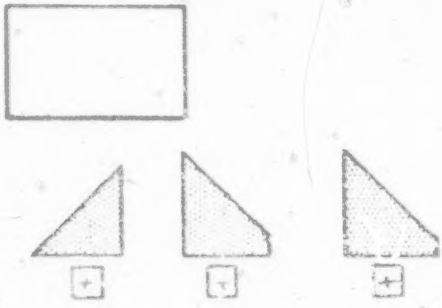
Suggested by Cards by L. L. Thurstone

Name: _____

FORM BOARD TEST -- Ex-1

This is a test of your ability to tell what pieces can be put together to make a certain figure. At the top of each page is a geometrical figure. Beneath each figure are several problems. Each problem consists of a row of five shaded pieces. Your task is to decide which of the five shaded pieces will make the complete figure when put together. Any number of shaded pieces, from two to five, may be used to make the complete figure. Each piece may be turned around to any position but it cannot be turned over. It may help you to sketch the way the pieces fit together. You may use any blank space for doing this. When you know which pieces make the complete figure, mark a plus (+) in the box under ones that are used and a minus (-) in the box under ones that are not used.

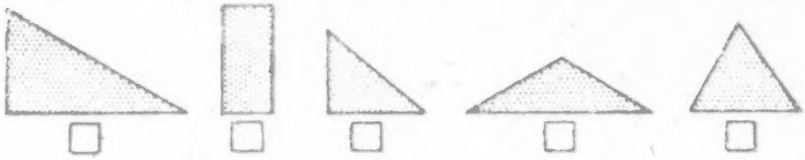
In Example A, below, the rectangle can be made from the first, third, fourth, and fifth pieces. A plus has been marked in the box under these places. The second piece is not needed to make the rectangle. A minus has been marked in the box under it. The rectangle drawn to the right of the problem shows one way in which the four pieces could be put together.



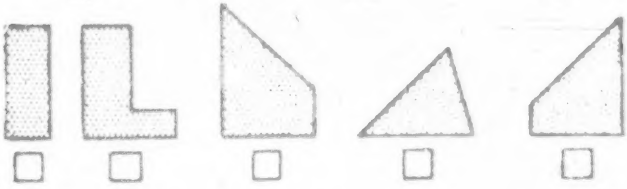
Answer

Now try to decide which pieces in Examples B and C will make the rectangle.

B.



C.



In Example B, the first, fourth, and fifth pieces are needed. You should have marked a plus under these three pieces and a minus under the other two pieces. In Example C, the second, third, and fifth pieces should be marked with a plus and the first and fourth with a minus.

Your score on this test will be the number marked correctly minus the number marked incorrectly. Therefore, it will not be to your advantage to guess unless you have some idea whether or not the piece is correct.

You will have 8 minutes for the 4 pages in this test. When you have finished these 4 pages, STOP. Please do not go on until you are asked to do so.

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Name: _____

GESTALT COMPLETION TEST — Cs-1

This is a test of your ability to perceive a whole picture even though it is not completely drawn. You are to use your imagination to fill in the missing parts.

Look at each incomplete picture and try to see what it is. Write on the line beneath it a word or a few words telling what the picture is. You need not describe it in detail; just name the picture or its important parts.

Try the sample pictures below.

A _____

B _____

Picture A is a flag and picture B is a hammer head.

Your score on this test will be the number of pictures identified correctly. Even if you are not sure of the correct identification, it will be to your advantage to guess. Work as rapidly as you can without sacrificing accuracy.

You will have 3 minutes for the 2 pages of this test. Please do not go on to the next test until you are asked to do so.

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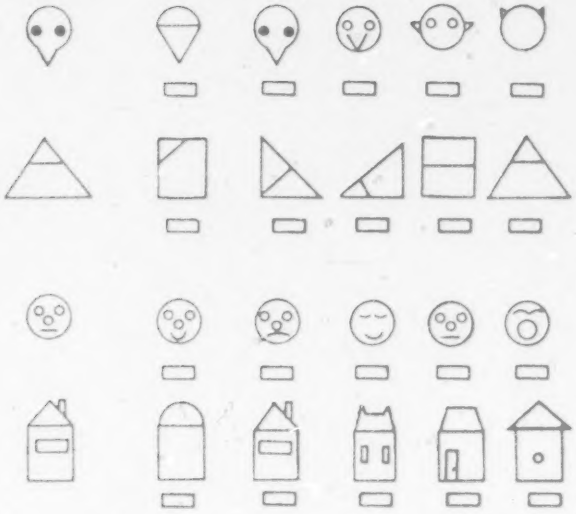
Name: _____

IDENTICAL PICTURES TEST — P-3

How fast can you match a given object? This is a test of your ability to pick the correct object quickly. At the left of each row is an object. To the right are five test objects one of which matches the object at the left. Look at the example below:

The third test object has been marked by blackening the space below it, because it is the same as the object at the left.

Now practice on the problems below. Mark them as fast as you can:



Your score on this test will be the number of objects marked correctly minus a fraction of the number marked incorrectly. Work as quickly as you can without sacrificing accuracy.

You will have 1-1/2 minutes for the four pages of this test. Please do not go on to the next page until you are asked to do so.

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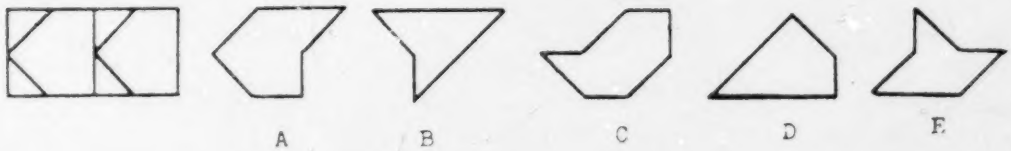
Suggested by Identical Forms by L. L. Thurstone

HIDDEN FIGURES

In this section you have a pattern on the left. On the right there are five figures. You have to find which one of these five figures can be found in the pattern on the left.

Look at the sample question below.

Example O

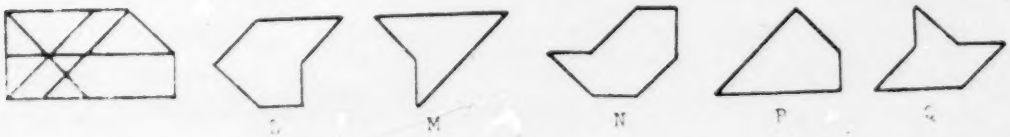


Put a large X over the correct answer.

The correct answer is A as figure A is the only figure hidden in the pattern. The figure below shows how figure A is hidden in the pattern.

You see that there are some extra lines passing through this figure. These extra lines are to make the figures harder to find.

Here is a sample question for you to try.



Put a large X over the correct answer.

There will be only one figure in each pattern. It will always be the same size and shape. <u>It will not be turned around or turned over</u>. Wordk as quickly and as accurately as you can. You should only guess if you can rule out some of the choices. Do not guess wildly. You will have <u>15 minutes</u>. There are four pages in this section. When you have finished the fourth page, STO

DO NOT TURN THIS PAGE UNTIL ASKED TO DO SO.